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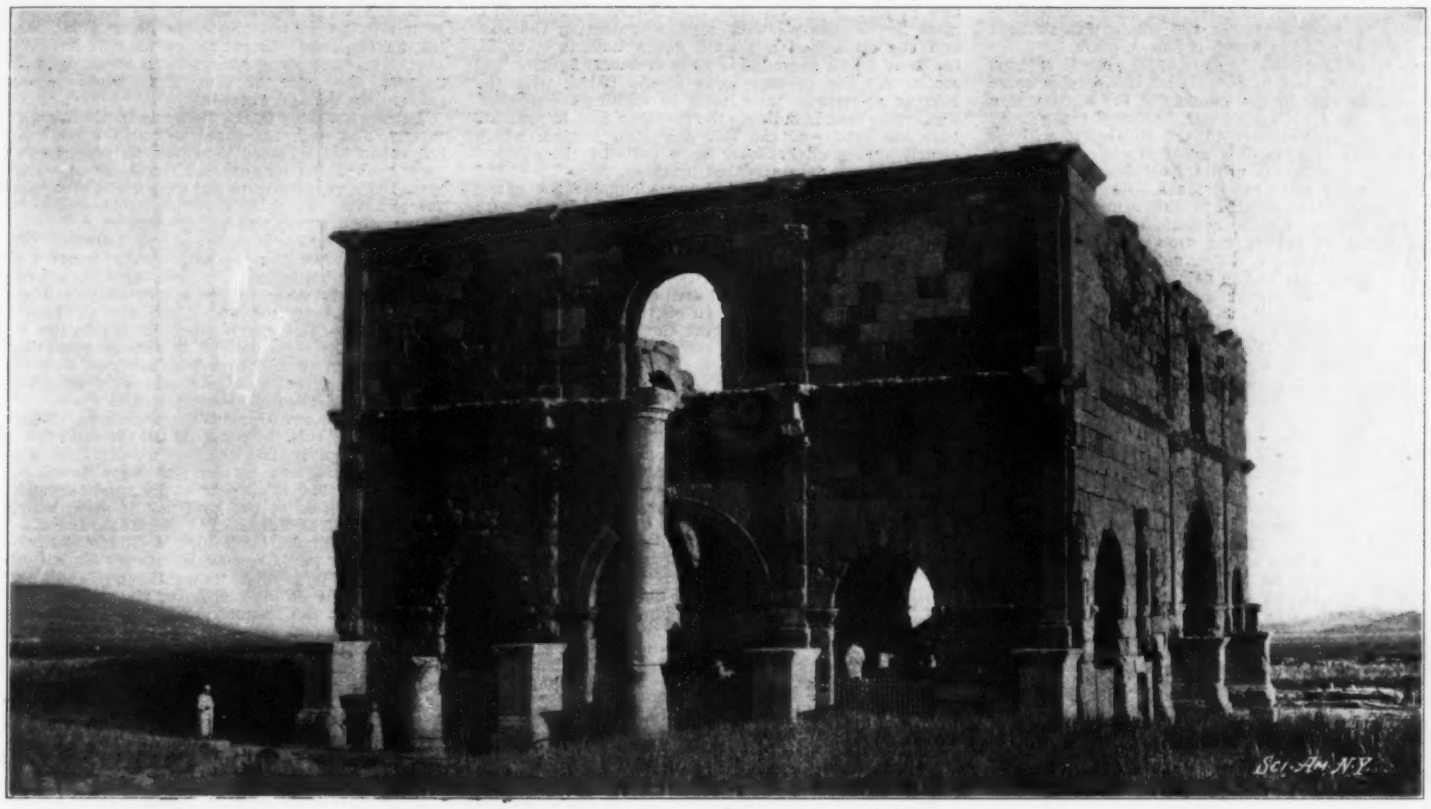


PRAETORIUM OF THE ROMAN CAMP AT LAMBESSA, AFRICA.

THE TRIUMPHAL ARCH OF THE ROMAN CAMP AT LAMBESSA, AFRICA.

THE ROMAN CAMP AT LAMBESSA, AFRICA.

CONSTRUCTION OF ROMAN CAMPS AS ILLUSTRATED BY THE REMAINS AT LAMBESSA, NORTH AFRICA.

By the Paris Correspondent of the SCIENTIFIC AMERICAN.

THE Roman camp and city of Lambessa (ancient *Lambaesis*) is one of the most prominent of the remains in the north of Africa. Its history is intimately connected with that of the III. Augustan Legion, which occupied the country during the period of the Empire. At the commencement of the second century (about 125), it received a great development under the Emperor Hadrian, who made it the headquarters of the African troops and went there in person to review the soldiers. Lambessa soon became the first military post in North Africa. A large and flourishing town grew up near the camp. Lambessa reached its highest prosperity under Septimius Severus, after which it declined owing to the removal of the troops. At the end of the 5th century its glory had waned into insignificance. In later centuries the whole was reduced to the state of ruins in which it now appears.

The camp of Lambessa, in spite of its present ruinous state, is the best, and in fact almost the only example of the method used by the Romans in the construction of their military retrenchments. Should the ground be excavated methodically in the future, it will no doubt afford a solution of a great number of obscure points relating to Roman military architecture.

In laying out a camp the Romans followed a well-defined method. Almost always the camp was established on a slightly sloping ground, so as to allow the general easily to survey the troops as well as the surrounding country. A water supply was furnished by a river or springs in the neighborhood. The camp was not to be placed near an eminence from which the enemy could explore it or throw projectiles. It is to be remarked that the site chosen for the camp at Lambessa fulfills all these requirements. The form of the retrenchments was nearly always rectangular, and the angles were rounded off so as to diminish the effect of projectiles. The interior of the camp was divided into four parts by two main avenues which ran parallel to the walls and crossed in the center. At the ends of these main thoroughfares were the four gates of the camp which were placed at the cardinal points of the compass. The gates were usually defended by projecting towers on each side, either round or square. The headquarters of the commanding officer were placed in the center of the camp at the intersection of the two main ways. The building here situated was known as the Praetorium, as originally the *praetor* was the chief magistrate in time of war. When the camp was only temporary, the officers camped in a tent like the soldiers, but where it was to be established for a long period, as in the present case, a more or less important building was erected for the officers and suitable lodgments for the soldiers. Thus at Lambessa, which was occupied by the III. Augustan Legion for about 200 years, the Praetorium somewhat resembles a Roman house, having an interior court around which were disposed the various offices and apartments.

The Praetorium, of which a view is shown in the engraving, is the most important and the best preserved of the structures at Lambessa. It is rectangular in shape, measuring about 76 feet on a side. Its four faces are almost alike, having a large central arch with a smaller one on each side. The exterior is decorated by superposed pilasters and had also a set of isolated columns resting upon pedestals. The keystone of the northern arch bears a Victory in relief, holding a palm branch. Statues were placed in niches on each side of the arch between the columns. The frieze has an inscription showing the date of the restoration of the edifice under Gallienus (268 A. D.) Of the four ways which led from the Praetorium, only two are completely uncovered. The Praetorian way, leading to the north gate, is visible over all its length, being a wide avenue laid with flag-stones in a remarkably good state of preservation. Scarcely a stone is missing over its whole length. The deep grooves which have been worn in the flag-stones by the chariot wheels are clearly visible, like those of Pompeii. The sidewalk is slightly elevated on either side. The total length of the avenue is 465 feet, and when it reaches the Praetorian gate it divides into two parts, a narrow one for the vehicles and a wider part for the footway. Enough of the Praetorian gate remains above ground to form an idea of its construction. It had a double vaulted passageway, and the remains of the sill which stopped the double folding gates are still visible. Two semicircular towers flanked the gate on each side. The interior formed the guard-house, and it is probable that the towers were connected in the upper story by a passageway running over the vaulting of the gate. This disposition closely resembles the fortifications of the middle ages. At Lambese, however, the walls of the camp were not surrounded by a moat, and the Roman writers state that moats were not dug around the camps except when these were situated in the enemy's country, which was not the case here.

The direction of the camp wall can be clearly followed on the north side. The wall was flanked at intervals by towers which, however, did not project, but were turned toward the inside, being used as platforms for the catapults and other machines. A partial excavation, which has been made at the northeast angle, shows that the thickness of the wall is less here than the main part. In the interior of the bastion which was constructed here were found a number of projectiles the size of an egg. These must have been used in the *ballistae* and catapults. From the four gates start the great military roads. The northern road divides into two branches, one of which leads across the country to Batna El Kantara, and Biskra, and the other to Constantine. The eastern route has also two branches, one running direct to Lebessa, by way of Timgad, while the second branch leads to the town and from thence joined the former. These military routes, which are now buried are recognized by the lines of tombs which bordered them as in the case of the Appian Way and the Street of the Tombs at Pompeii. At Lambese the roads were bordered on each side by tombs or mausoleums, some of which are still standing. The most remarkable of these tombs is that of Flavius Maximus, prefect of the legion. The tomb is about two miles from the camp. In order to restore it, it was taken apart in 1849, and at 3 feet below the ground was found a lead receptacle containing a glass lamp and a pottery vase with the ashes of the defunct. The whole was put back in place and the tomb re-erected.

The Baths of the III. Legion are the most important of the remaining structures of the camp. They were excavated in 1862 by Cherbonneau. He uncovered two main chambers and revealed fine mosaic floors. Three years later Barneond continued the work and uncovered various chambers whose walls were decorated with fresco paintings distributed in panels, which represented imitations of marble alternating with allegorical figures. He found the swimming tanks still intact, with their cement covering and all the mosaic floors in place. Unfortunately there remains but little of all this at present. The best of the mosaic floors had two large medallions surrounded by arabesques and geometric figures. One of the circles contained a male figure crowned with rays, representing the sun, and the other had a female figure holding a torch, the head being surrounded by a crescent, figuring the moon. All the sub-structures of the Baths, with the heating apparatus, were then in excellent condition. The bricks used in building the furnaces and hypocausts bore the stamp of the III. Augustan Legion, which clearly indicates that they were built by the soldiers and with materials prepared by them.

The town of Lambessa, lying alongside the camp, affords an interesting field for the archæologist, with its double Forum and various temples and other edifices. The town, which flourished during a period of three centuries, must have contained from thirty to forty thousand inhabitants. One of the best preserved monuments is the triumphal arch shown in the engraving, which bordered the town on the side next to the camp and dates probably from the reign of Septimius Severus.

DOMESTIC LIFE IN PERSIA.

By ELLA C. SYKES.

IN order to understand Persian domestic life, we must carry ourselves in spirit back to the patriarchal age. In Persia, at the present day, the master of the house is lord, much in the same way as were Abraham and Jacob. He has large powers over the persons of his wives, children, and dependants, being able to treat them pretty well as he pleases.

Owing to the seclusion of the women, he is practically the sole judge to whom his wives can appeal, and though there are certain laws for their benefit in such cases as divorce, yet it can easily be seen how difficult it is for them to get justice. In fact, a wife is looked upon as a chattel, a possession of which her husband is jealous, more from etiquette than from affection.

With the children it is something of the same kind; they are not individuals, but property belonging to the father, who makes but little account of his daughters, and only cares for his sons if they are handsome and clever.

Then come the servants. They occupy a curious position, chatting freely with their masters, offering them advice on all occasions, collecting gossip from the bazaars with which to amuse them, and yet liable to the *bastinado* for trivial offenses. They seldom change their situations, and the children of servants are frequently educated with those of their master, joining them in their sports on terms of the greatest intimacy. Yet, as a Persian gentleman explained to me, these customs are not from lack of the caste feeling, but rather because the divisions between the different classes are too clearly defined to be bridged over.

It is amusing when receiving a Persian of position, to notice how his servants, and yours for the matter of that, will burst into the conversation at intervals, leading it much as they choose. That passage in the Old Testament where Naaman refuses to obey the Prophet's command to bathe in the Jordan, and is argued with, and finally persuaded by his servants, is a true picture of the relationship between master and servant in Persia at the present day. Any gentleman intimate with another will invariably inquire after his friend's chief servant, and address some of his conversation to him, and it is a mark of special friendliness to give orders to another man's retainers. A Persian prince, who often dined with us, used to send our servants (who were waiting at table) for this and that, and I confess that I thought his manners strange, until it was pointed out to me that he was paying us a particular compliment.

Also when we rode with our Persian acquaintances, the latter would by no means accompany us the whole time, but would very soon hang back to gossip with our grooms, presumably questioning them about us and our strange European ways.

All servants are fed and clothed by their masters, and are supposed to get a certain amount of cash, at all events in the towns, but this I fancy they seldom see, as it is extremely difficult to get ready money out of a Persian. A European friend once asked a Persian how it was that his servants stayed in his situation when he never paid them any wages, and he answered with a laugh, "I keep them by means of lying promises!"

If there happen to be any poor relatives, they are treated much like the servants, and act the part of hangers-on for free board and lodging.

Slaves, strange as it may seem, are most important and considered members of a household. For one thing they are valuable, and must never be put to do hard work, and the Persian theory is that as they have no ties of their own they will be the more likely to identify themselves with the interests of their masters. Accordingly, a Persian will entrust his money and property to his slave, and often confides his children to him on his death-bed. This relationship, however, is fast dying out, as the supply of slaves has been cut off, and it is now very difficult to smuggle such contraband cargo into the country.

The dwelling houses in Persia are always built round courtyards into which the doors and windows open, and are inclosed with high walls, over which it is impossible to see. A heavy door on the street admits the visitor into the *biroon*, or outer apartments. These are only used by the men, and are generally scantily furnished rooms opening on to a tank in the middle of a badly-kept yard. No idea of the wealth or culture of a Persian can be gained by his *biroon*, where he transacts his business, and receives his friends. These, by the way, however intimate they may be, must never ask after or allude to their host's wife and family, except by the vague term of *khana*, or "the house."

A dark passage, with a door at the far end, leads from the *biroon* into the *anderoon*, or women's apartments, and here things are very different. Flowerbeds surround the courtyard tank, and the rooms have rich carpets, silken divans, enormous silk-covered cushions, and are decorated with inferior European pictures and knicknacks, frequently in the worst possible taste. Occasionally, however, some conservative Persian will cover the ceiling of his room with scraps of mirror set in the plaster at different angles, making an exquisite decoration, or he will have rows of graceful niches along his walls, in which he will place quinces, the odor of that fruit being particularly grateful to Persian nostrils.

Here the master of the house is in the bosom of his family, and with his shoes left at the door, and his astrakhan hat replaced by a felt skull-cap, he is at his ease, though the long-skirted frock-coat and the European trousers, now worn by all, are not ideal garments for a nation which sits on its heels, and only uses chairs when Europeans are present.

A Persian's day is somewhat as follows: He rises about six o'clock, a servant pours water over his hands, and he bathes his face, and then prostrates himself in devotion on his prayer carpet. A glass of much be-sugared tea and some almond paste serve him for breakfast, after which he begins the work of the day. The term "work" is perhaps somewhat misleading when applied to a Persian, who does not happen to be a governor, a merchant, or a peasant, all of whom have occupation enough and to spare.

Most of the country gentlemen possess villages, and of course see that the peasants till the land farmed out to them properly, and there is a busy time when the crops are gathered in and the wine is made. But apart from this, it appears to be ample occupation to act as hanger-on to the governor or great man of the place, and, if at Teheran, to the Shah and his Vizier. Certainly this rôle takes up a considerable amount of time, for the would-be courtier spends his entire mornings in the large hall where the governor dispenses justice. This is dignified by the name of "doing service," and the magnate thus honored looks upon it as a compliment.

Again, talking is a never-failing resource, and Persians so greatly enjoy discussions on religion, that I fear some missionaries, on first arriving in the country, may have entertained vain hopes of speedy conversions when they saw how ready the educated men were to hear about the doctrines of Christianity. The love of *gufti gu*, or chatter, is ingrained in every Persian and, at night, the servants will tell stories into the small hours of the morning unless checked by their employers.

Music and dancing are also much practised. Although no gentleman would degrade himself by doing either personally, yet he will listen for hours to the twang of the *sitarrah*, the thud of the *tom-tom*, and the falsetto voice of some trained singer.

The cult of the supernatural is a constant occupation. No journey can be taken, no doctor called in, often not even a new suit can be worn without consulting the astrologer, and no one would enter a city or house for the first time, or close any important bargain, unless the omens were auspicious. Again, there are many unlucky days, no one, for example, ever commencing any undertaking on a Friday, which is equivalent to our Sunday.

A traveler may have secured good omens for a journey, yet if he or anyone else chances to sneeze as he mounts his horse, he will almost certainly put off his start to another day. The less superstitious will repeat a certain invocation to Allah, which is supposed to nullify the bad effect of the sneeze, but even these partially emancipated spirits will proceed on their way haunted by a sense of impending disaster.

Persians also believe that a day is lucky or the reverse according to whose face they have looked upon first on awakening. The "lucky" face or its contrary can only be discovered by experience, but such people as public executioners and their children are always credited with unlucky visages. It can be understood from this that a master is very particular which servant calls him in the morning.

When other ways of filling up his day fail him, a Persian has recourse to slumber. He appears to be able to sleep at any odd moments; and once my brother counted up the time spent in this occupation by a gentleman whom he knew well, and made it out to be sixteen hours in the twenty-four. While agreeing with the amount, our friend said that during a good deal of the time he was not actually asleep, but was meditating on pleasant things while lying down! Certainly no Italian understands the art of *dolce far niente* better than a Persian, and our bustling, energetic lives seem the height of folly to him. He is well content with the world of Omar Khayyam:

"A Book of Verses underneath the Bough;
A Jug of Wine, a Loaf of Bread—and Thou,
Beside me, singing in the Wilderness,"

the "Thou" in his case being no fair lady, but a hired musician.

A Persian governor, however, is a really busy man, for having given a large sum to the Shah for his province, he has to work hard to wring money out of his unlucky subjects wherewith to recoup himself. At an early hour he will proceed to his hall of justice, which will be filled with men of position, anxious to pay court to the powers that be, with numerous retainers, and with a crowd eager to get their cases settled, for the governor of a province is also its magistrate and judge.

In Persia, the man who has the longest purse wins

his suit, and the bystanders naturally take a keen interest in the judgments dealt out. The governor by no means confines himself to large matters. Like Moses, before the Lawgiver followed Jethro's excellent advice, the Persian ruler adjudicates on the most trivial details, appearing to have no sense of proportion. His *ferashes* are in readiness to carry out the punishments he may decree, being prepared to cut a man's throat, take off a hand or an ear, blind an unlucky prisoner, or subject him to the *bastinado*.

At noon a leather cloth is brought in, and unrolled upon the floor, and metal bowls of food are placed upon it. When the governor and those whom he invites to share his meal have done their mid-day devotions, they partake of *pillaus*, *chilaus*, *kabob-i-sikh*, and other dishes, helping themselves with their hands, and drinking glasses of sherbet. When this meal is cleared away by the servants who feed on what is left, everyone has a *siesta*, and later on, if the governor be not too busy, he may ride out to some garden with his friends. Here he will smoke innumerable *kalians*, drink tea or wine, and quote from Hafiz and Sadi to show his culture. Probably he and his party will have another sleep in the hot afternoon, lulled by the rippling stream which flows through every Persian garden.

If, however, he is a man of active tastes he will be a devotee of sport, riding out on the plains with his friends and retainers to chase the gazelle. This is done by inclosing the animals in a circle, which becomes narrower as the riders get nearer. When they are close upon the gazelles, the latter try to break through the ring, and an exciting moment ensues of rather indiscriminate firing, which often results in casualties to the hunters as well as to their quarry.

Or a partridge shoot on horseback may be organized. A narrow valley is often selected for this sport, the riders scouring the hills on either side, and galloping along precipitous ridges in order to force the active little *chikor* down into the gorge, where eager sportsmen fire upon them at the closest of ranges. Mongrel pointers are on the alert to put the birds up, and frenzied falconers gallop to and fro, letting loose their hawks and shouting wildly. One and all appear to use their guns very carelessly, and the hurly-burly and excitement are quite indescribable.

It was on one such occasion that as we were starting from camp in the company of our host, a certain Persian prince, his favorite servant galloped up to us calling out the magic word *shikar*. At once the whole party stopped, and the prince, dismounting, cocked his gun and cautiously approached the game. I was puzzled at seeing no partridges, and my surprise was not lessened when our host fired at a small bush out of which suddenly emerged a fine magpie, which flew off unharmed!

After the work of the day, the Persian evening meal, if eaten in company, is not served till close on midnight. Before the dinner proper appears, the guests spend two or three hours eating dried fruits and almonds and drinking wine, unless they are stricter Mohammedans than is usual. The belief that for each glass of wine drunk on earth the expiation in the next world is a draught of peculiarly loathsome water, does not seem to deter them in the least from partaking of the forbidden luxury.

When dinner, a replica of the midday meal, comes at last, everyone goes to the tank in the courtyard to wash his hands and mouth. If this ceremony were omitted, the wine drunk would defile the dishes in which the food is served, and they would have to be subjected to a laborious scraping before being used again. Then the meal is eaten in the greatest haste, hands and faces are washed, coats and hats removed, and everyone goes to sleep.

This custom, which seems likely to induce nightmare, may have something to do with the universal belief that ghouls and demons are on the alert at night ready to destroy the unwary, and many rich men pay a priest to sleep with them on this account.

Such unpleasant supernatural visitants as *ghouls*, *divs*, *jins*, *afrits*, and the like, have to be constantly taken into account, and the boldest Persian would hesitate to venture unaccompanied into a lonely graveyard, or a deserted ruin. They say, however, that these places would be divested of their terrors if a European were present, the reason given being that the bogies only reveal themselves to those who believe in them.

Having given a glimpse of the life of a Persian gentleman, I will now turn to the ladies, whose existences, according to European ideas, are decidedly dull and restricted.

When we consider that except her relatives, the only man who has the right to look upon a woman's face, is her own husband, it may easily be understood that there is practically no social intercourse between the sexes.

A Persian told me that it would be entirely against etiquette for him to salute his mother or wife did he meet them outside the house, and happen to recognize them under the shapeless black shrouds in which they would be huddled.

No gentleman is ever seen with his wife in public; he cannot ride, drive, or walk with her—in fact the couple have so few interests in common that he spends his days with his men, and she with her women friends.

If she is one of the wives of a rich man she will have her own establishment, but supposing that the husband is poor, he may have more than one wife under the same roof. There is a significant Persian proverb to the effect that, "Two mistresses cannot be at peace in one house," and the quarreling, intrigue and heart-burning that inevitably ensue in such a case, may be left to the imagination.

Persia, however, is becoming monogamous, and Persians themselves say that it is unfashionable and provincial to have more than one wife, but really it is the general poverty of the country which is chiefly answerable for this change in Mohammedan custom. Certainly there is a saying, "It is easier to live with two tigresses than with two wives," but I fancy that few men would hesitate to make the venture if only their means were sufficient.

The Persian girl is brought up with her brothers until she is eight years old, and usually it is not considered worth while to teach her reading or writing. She learns how to make sherbets and sweets and to embroider, and is married at an early age, usually to a cousin.

Betrothals are often arranged by a professional go-between, who is treated with much respect by all who have marriageable sons and daughters, as it is in her power to make or mar a match. Supposing that a desirable *fiancé* is found for a girl, and that her dowry is satisfactory, the gentleman's mother and other female relatives pay a visit of ceremony to inspect the young lady. Of course, the girl knows for what purpose they have come; and if the idea of the marriage has not found favor in her eyes, she will hand the tea and water-pipe to her would-be mother-in-law in such a rude fashion that the negotiations will be brought to an abrupt conclusion.

On the other hand, she may know her proposed husband well by sight, as her servants may have pointed him out to her in her walks, and if his appearance has pleased her all goes smoothly.

In her turn, she and her relatives will go to drink tea at the house of her intended *fiancé*, and she will try and look her best, knowing that the young man, hidden away on some balcony, is anxiously watching his mother, who will point out to him his future wife.

He is not supposed to see her face until the formal betrothal by the priest takes place, and then, indeed, she will be so rouged and powdered and her eyebrows and eyelids so blackened with antimony that it will be hard for him to gain any clear idea of what her natural charms may be. However, if what he sees displeases him, he may draw back by paying to the lady's parents half the sum of money that they had agreed to give as dowry, but a man behaving in this way is socially disgraced.

At the ceremony of betrothal a lighted candle, the Koran, and a mirror, together with a tray on which are tapers, perfumes, dried seeds and dates, are placed close to the girl and a green covering thrown over her. She must not speak to anyone, and a lighted lamp is then put beneath a large brass basin turned upside down, and on this latter a saddle and pillow are placed, and she sits on the pile to indicate the mastery of the husband. The same green covering conceals her later on during the marriage-ceremony, and when wedded she is given a piece of gold for luck, and carries bread and salt into her husband's house to insure plenty, kissing the hearthstone of her old home as she leaves it.

The marriage is a grand affair, Persians often going deeply into debt on these occasions, as they feast their friends, the priests, and the beggars on a large scale, and entertain them with hired musicians and buffoons. It seems a matter of chance whether the young wife has a happy life or the reverse, as her fate depends so greatly on the character of her husband, and also whether she becomes the mother of a son. She can be divorced with ease, and, at any rate, a cruel blow can be inflicted upon her by the addition of a second wife whom her husband may prefer to her. From early youth the husband has been taught by the priests to pay no attention to the counsel of a woman, in fact, that he had better act in every way contrary to her advice. He also believes that women have practically no souls, and that he will never meet those he has known on earth, when he attains to the material Paradise of the Mohammedan. *He* will be tended by fair *houris* who sing entrancingly as he sits beside the River of Milk, or stretches his hand toward the delicious foods with which the boughs of a certain wondrous tree are laden. *She*, on the contrary, may be writhing in hell, as the Prophet told his followers that when he was permitted a glimpse into the infernal regions the vast majority of the victims there were women.

Only by continual effort, and by making pilgrimages, can a woman be admitted into the paradise reserved for her sex, which is a very inferior place of residence to that which her male relatives will inhabit, with apparently but little trouble on their part.

There is certainly a good deal of wifely submission in Persia, and only once did I hear of a hen-pecked man. On one occasion, I remember calling on a lady when her husband was present, and the latter asked me whether I thought his wife was pretty, much in the way he would have discussed the points of a horse or a dog. I noticed how ill at ease the poor woman was, and he actually pointed this out to me, adding that if they were at table together, she would tremble in every limb from fear of her lord and master. After this experience, I was not surprised that nearly every native lady I met advised me earnestly not to wed a Persian, assuring me that they made very bad husbands. This was quite a spontaneous warning on their part, because I always made a point of never comparing their lives with my own, fearing to stir up discontent, for which I could offer no remedy.

However, I was by no means so reticent with the men when they compared European and Persian women to the disadvantage of the latter, and I soon saw that the more thoughtful were by no means content with the status of their womenkind. I remember one man exclaiming in a burst of indignation, "It is all the fault of our cursed religion, which binds us in chains, as well as our poor women!" This is neither the time nor the place to discuss Mohammedanism, but it always appeared to me to be one of the most petrifying of religions, seeming to hold its devotees in a grip that admitted of no progress or expansion.

In Persia, Friday, as in all Mohammedan countries, is the great day of the week, every pious son of the Prophet repairing to the bath, and then to the Mosque.

The ladies, however, spend their time in the former place, and, indeed, we cannot blame them, for the only accommodation provided for them in the House of Prayer is an inclosure screened off from the rest of the building by a closely barred lattice, through which they can get glimpses of the proceedings, while remaining unseen themselves.

They use the bath as a kind of club. There they meet their friends, show off their new dresses and best cushions, and are particular as to the embroidered cases in which they carry their toilet requisites. Accompanied by their children and servants, who are admitted free of charge, they pass the entire day in the hot, steamy atmosphere, gossiping while their hair and finger nails are dyed with henna, and their eyes and eyebrows decorated with antimony.

There is a good deal of sociability among these ladies, and they are fond of having their friends to stay with them; indeed, an acquaintance told me that, by skillful use of lucky and unlucky days, a lady would inflict visitors upon her husband, who is obliged to make himself invisible on these occasions, for longer periods than he liked. For example, those who were in a house on Saturday must stay there on the Sunday night, while any who arrived on the Tuesday or Thursday were forced to spend the Wednesday or the Friday under the same roof, an earlier move bringing ill luck to all concerned.

Persian women frequently give parties, and on these occasions wear their best dresses and jewelry, a man being looked upon as a good husband according to his capacity of providing finery for his wife.

At Teheran, a lady will pay a large sum at the European shops for a piece of brocade, and will wear it ostentatiously in order to excite the envy of her guests. Retribution, however, may overtake her, for one of her visitors will perhaps buy more of the same material, and have it made up for her slave-girl. She will then invite all her acquaintances, and tea and water-pipes will be handed round by the slave dressed in the rich silk in which the quondam hostess is probably arrayed. Later on the same girl will dance before the assembled guests to the intense mortification of the one and the keen amusement of all the others!

When a Persian woman is advanced in years, she often thinks of that inferior paradise to which she can so hardly attain, and she will persuade her husband to let her go on a pilgrimage. If possible, Mecca or Kerbela will be her goal, though if lack of means put these shrines out of her reach, Mecca in particular requiring a long purse, she will perforce renounce the coveted titles of *Haji* and *Kerbelai*, and be content with that of *Mashtadi*.

But even the journey to the famous shrine of Imaum Reza at Meshed is a serious affair for a woman. She must travel in the jolting *kajaveh* or pannier strapped on to a mule, and in which she must sit in a very cramped position, unless she can afford the expensive swaying *takht-i-ravan* or litter.

We must also remember that her outer garment is a black silk shroud in which she is covered from head to foot with the exception of a strip of lacework over the eyes, and that however hot the weather may be, she cannot uncover her face, and however ill she may be she has no better hotel than the miserable *caravanserai*, with only recesses innocent of doors and windows opening off from the courtyard. Her servants will sweep out one of these cells, lay felts and her bedding on the mud floor, and hang a carpet across the opening, and here she must pass the night in close proximity to the camels and mules, and probably be kept awake by the conversation of the muleteers lying just outside.

When the goal of her journey is reached after many weary days, if not weeks, of travel, she will probably settle down for a year, visiting the Mosque daily, and presenting offerings of gold and jewelry to the shrine. She will pay a priest to recite portions of the Koran to her, as it is improbable that she can read the sacred book herself, and she will pass much of her time chatting with friends from her native city who meet her in the screened-off part of the Mosque.

She does not trouble herself about the husband and children whom she has left, for she has never seen much of the one, and the others are safe in the care of a faithful slave. As for the house, she has never been its real mistress, her husband having always managed the servants and paid for everything; therefore, it will go on just as well without her as with her.

We must now turn for a few moments to the Persian children. For some time after birth they are kept tightly bandaged, and I fear are often dosed with opium if fretful or sleepless. Their mothers and nurses are constantly occupied in their endeavors to ward the evil eye from their charges. Blue is supposed to be the best color for this purpose, and many children wear an amulet made of a sheep's eye brought from Mecca, into which a turquoise is stuck. Another plan is for rich parents to dress their children in very shabby clothes, lest anyone admiring the young folk and omitting to add the saving word *Mashallah* (God is great) to their remarks should bring disaster upon them.

Most childish and, indeed, most adult illnesses are put down to the evil eye, and the cures are all more or less a question of charms. For instance, a poor baby suffering from water on the brain was brought to a Persian doctor who assured the parents that it was possessed by a demon. His prescription was as follows: The father was to lay his child in a newly dug grave and leave it there for the night. In the morning it would either be cured or made away with by the demon. The parents followed the doctor's advice, and next day great was their surprise to find their baby sleeping in its strange bed neither better nor worse from this novel cure.

But there is no end to the remedies to which Persians will resort. Some are extremely unpleasant, and others have a touch of the "gorgeous East" about them, such being the ground-up pearl, which is administered as a powerful restorative to anyone at the point of death, and the powdered rubies and emeralds which are supposed to act as tonics.

If the Persian boy does not succumb to any illness he is taken from his mother at an early age, and handed over to the care of the servants, by whom he is trained to be an exact copy of his father.

No romping or running is allowed, such being considered undignified proceedings on the part of a gentleman, and the poor child is always treated as if he were grown up. He is made to sit still when with his elders, is dressed exactly like them in miniature, is instructed in an elaborate code of manners, and shares in the Persian dinner, which often begins at midnight.

No Persian of position ever sends his sons to school, but engages a priest to come daily to the house to teach them to read the Koran, Sadi, and Hafiz, and to instruct them in writing.

The education of the boys begins at five years of age, and if they decline to learn, two *ferashes*, kept

in readiness outside the schoolroom door, are called in by the tutor to apply the *bastinado* to the soles of any unruly pupil. As the teacher is only paid about £1 a month, it is hardly to be expected that he can be a profound Arabic scholar, and the result of his training is that most boys can read the Koran glibly, but have not the least idea of its meaning.

As to general information, I hardly think that there is such a thing in Persia. One gentleman, who had been to England, told me that his priest had taught him that the Atlantic Ocean was a large city in France, and the rest of his instruction was on the same level.

Even when the boys are free of their tutor, they are placed under the care of a *lala*, an old man who performs the functions of the Greek pedagogue, taking his charges out for walks, and keeping a keen eye on their movements.

This restricted life, so devoid of freedom and healthy exertion, has probably much to do with the poor physique of the upper classes, and helps to account for the enormous mortality among Persian children, it being stated that only two out of every six survive.

Europeans coming to Persia are often delighted with the finished manners of any little boy they may meet. A child of seven will receive them with the *aplomb* of a man of the world, ordering the servants to bring tea and sweetmeats, and entertaining his guests with conversation or with a recitation from some poet, but such accomplishments are acquired at a heavy cost.

Fathers often show but scanty affection for their children. One gentleman told me that his son was hardly more intelligent than an animal, because the youth could not master French. The young fellow did not resent this remark in the least. He said that he was his father's servant, and must submit to any kind of treatment from him, because his parent performed the seemingly obvious duties of feeding and clothing him. Another Persian described to me his home-coming from a successful career at the military college at Teheran. He hastened to greet his father, who sat surrounded by his servants, and hardly deigned to notice his son, telling him to retire at the end of a few moments. The young man was so overcome with mortification that he rushed from the room, and would have made away with himself had not an old retainer followed him and prevented the rash act.

Persian boys are instructed in the tenets of their religion by the priests, and though I am far from saying that there are no convinced Mohammedans in Persia, yet I only came across one in the upper classes, and was told more than once by acquaintances that they perform their devotions to impress the servants.

Almsgiving seems to be looked upon as a kind of insurance against the evils of this life. No Persian would think it quite safe to go on a journey without giving money to the poor, and if he were saved from any accident the numerous beggars would benefit, not so much from a sense of gratitude as from the idea of guarding against a future disaster.

Lying is looked upon as a fine art, and the man who takes another in successfully is applauded, while he who deceives clumsily is regarded as a fool. Patriotism and bravery are decidedly at a discount, and the youthful Persian of to-day is very unlike his ancestor as depicted by Herodotus. During my stay in Persia, I was often asked at what date the English army was to land on the shores of the Persian Gulf and proceed to take the country, this idea of a foreign occupation being highly approved by all.

On one occasion two officers, whom I knew, were discussing an expedition that they had undertaken against a turbulent nomad chieftain. A cloud of dust had been seen in the distance, and one of my acquaintances believing that the enemy was approaching in force, turned to fly, with all his soldiers following closely in his wake.

This incident was related by his brother officer to an amused group of Persians, and the narrator was not in the least abashed when his colleague turned the tables upon him with, "Yes, that was the time when you were so frightened that you stopped a riding-camel and crept into one of its saddle-bags!"

The point of the story was that the cloud of dust had been caused by a stampede of mares, and after the foregoing conversation, I was not surprised to hear that the nomad chieftain was still at large.

Time fails me, and I must not talk longer about Persian life, though I feel that I have only touched the fringe of my subject. I do not, however, wish to leave the impression that I take a gloomy view of the Persian character, for I confess to having a strong liking for the kindly, quick-witted, courteous sons of Iran. I have tried, as far as I have gone, to give a true picture of Persian upper-class life, and my paper is the result of over two years' residence in the country and somewhat unusual opportunities of mixing with its inhabitants. Yet, much as I sympathize with Persians, and grateful as I am for the unvarying kindness shown to me by high and low alike throughout my visit, it is almost impossible not to judge Orientals by a Western standard.

"For East is East and West is West,
And never the twain shall meet,"

is a true saying, and it requires a penetration almost approaching to genius before a European can be quite fair to the Oriental point of view. There are such people as Orientalized Europeans, but they remind us of the Persian proverb coined for such cases: "The crow tried to walk like the pheasant, but he merely spoilt his own gait and became ridiculous for his pains."—Journal of the Society of Arts.

NEW STEREOPTICON APPARATUS.

DOUBLE Installation for Projections.—At present, scarcely any magic lantern exhibitions are given in which the spectators are satisfied with inanimate views, and so motion has to be added thereto. The cinematograph has become so common that there is no longer any country town, however small it may be, that has not its moving picture exhibitor. In order to pass from inanimate to animate projection, it is necessary to have two distinct installations, and it is usually the custom to give two exhibitions, with a somewhat lengthy interval between them. In many cases it would be preferable to have the possibility of interposing an animate view at any moment whatever; and sometimes this might even prove very useful for lectures in which demonstration requires a great variety of images on different scales and from very diverse points of view. It is in order to facilitate this sort of mixed projection, so to speak, that M. Gaumont has devised the double installation represented in Fig. 1. The lantern proper, which is of sheet iron, is provided with two condensers—one for animate projections, protected by a water tank, *E*, and the other (a larger one) for inanimate projections. At the rear, a carriage supports the electric regulator, which, by means of an actuating bar controlled by a handle, may, at will, be brought opposite one or the other

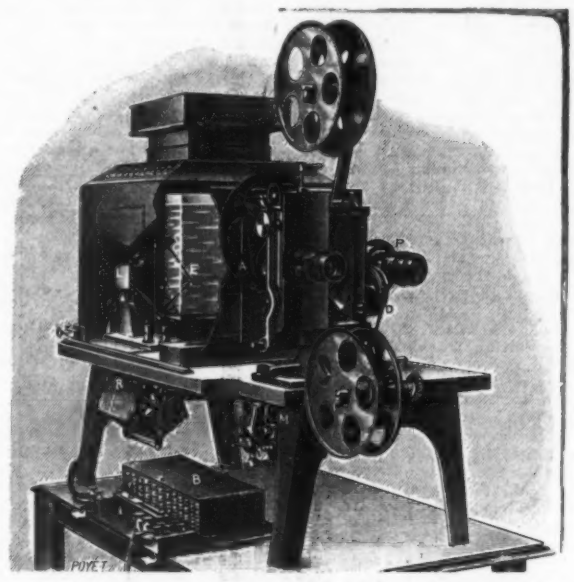


FIG. 1.—DOUBLE INSTALLATION FOR PROJECTIONS.

of the condensers. Stops placed upon the bar permit of registering the precise point at which the light is well centered. The condenser that is not in use is automatically concealed by an iron plate, in order to prevent any loss of light. A rheostat, *B*, of very peculiar construction, prevents heating and permits of the regulation of the lamp. Upon the front of the lantern are mounted, on one side, the objective, *P*, and a holder for the easy introduction and removal of the slides, and, on the other, the cinematographic apparatus. The two objectives are so calculated as to give sensibly the same dimensions upon the screen.

The cinematographic part comprises a Demeny apparatus, *A*, provided with its objective, *C*, and a peculiar arrangement that permits of centering the image very quickly. Two reels with wide cheeks, one placed above the other, serve to hold the films, which are sometimes nearly 2,000 feet in length. Upon the first is placed the band all wound up, and to the second is secured the end that has traversed the apparatus. A belt, *D*, connects the second reel with the film-moving mechanism, and the film is wound up as fast as it passes behind the objective. The electric motor is regulated by means of a rheostat, *R*, which permits of varying the speed of unwinding at will. It is always possible, at any moment whatever, to arrest the animate projection in order to pass instantly to the inanimate, and to show, for example, a detail that has been photographed on a larger scale and with a better light. This double installation is well established upon a table upon which are assembled all the parts in such a way that they shall be within easy reach of the operator and that the whole shall occupy as little space as possible.

The "Etincelante."—For any one that has at his disposal a source of electricity sufficient to supply an 8 or 10 ampere arc lamp, projection is easy, but this is exceptional, and in many cases it is necessary to seek some other source of light. It is to oxygen that recourse will be had in the first place, and from this there may be obtained a light equal to that of the electric lamp, especially with the new oxygenator apparatus in which oxylith is employed. But there are many amateurs, professors, and lecturers who, for diverse reasons, cannot employ apparatus that necessitate quite a heavy expense as regards purchase price and cost of carriage, and are therefore obliged to be content with a lantern lighted with kerosene that can be easily carried anywhere and be instantly installed in any place whatever. Such persons may also employ the incandescent kerosene lamp, a type of which, devised by M. Turillon and called the "Etincelante," permits of lighting perfectly a 4 x 5-foot screen. This lamp consists of two reservoirs, *P* and *A* (Fig. 2), one for the kerosene and the other for compressed air, and a burner, *E*, in which the Auer mantle is employed.

The air is compressed in the reservoir, *A*, by means of a bicycle pump. A special expander, placed at the end of the tube that connects it with the reservoir, *P*, permits the air to exert a constant pressure upon the kerosene, which it drives into the flexible tube, *V*, ending at the burner. The flow in this tube is regulated by means of a needle valve. In order to light the lamp, the jacket, *C*, is raised by means of the handle, *L*, and upon the base, *K*, of the burner are placed two balls of asbestos saturated with alcohol, which, when ignited, start the vaporization. At the end of two or three minutes, a flame is held above the mantle, *H*, which soon becomes incandescent, and gives 8 or 10 carcels. A steel needle is so arranged as to be always in the burner when the lamp is in an inoperative state, and, by actuating this by means of the handle, *M*, once or twice during the operation of the lamp, the capillary conduit is prevented from getting clogged. The centering of the luminous point can be done either vertically or horizontally by means of rods, *R* and *S*, the extremities of which terminate in buttons placed behind the reservoirs and within reach of the hand when the lamp is in place in the lantern. As the mantle, *H*, is of very small size, the light is concentrated upon a small space, and this is very advantageous for obtaining a uniform illumination of the screen.

As the kerosene is vaporized, it is entirely burned, and emits no odor. The length of the tube, *V*, prevents the heat from communicating to the reservoirs and arrests all dangers of explosion. Moreover, the heat disengaged is relatively slight, and much less in all cases than that given with lamps or two or three wicks, which always smoke but never illuminate.—

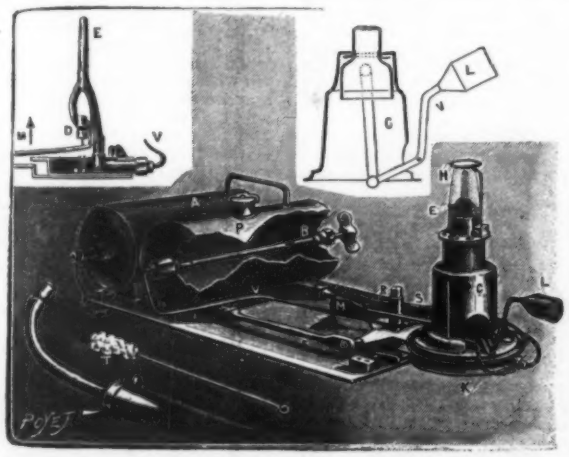


FIG. 2.—DETAILS OF THE MECHANISM OF THE TURILLON INCANDESCENT LAMP—THE "ETINCELANTE."

Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

In New York city at least it would seem that everything could be hired. According to the New York Sun, if a man had occasion to use a steam boiler, he could hire it just as he could hire a yacht or a piano. Occasionally one comes across something to be let that does at first thought seem a little odd. Who, for example, would ever think of hiring wreckers' air bags? And yet this strange commodity seems to have been called for. Not everybody who might have occasional use for it would want to keep on hand an air-bag outfit, such as would be required to raise a large vessel. He could hire it more cheaply.

THE DEVELOPMENT OF MARCONI'S SYSTEM OF WIRELESS TELEGRAPHY.*

By EMILE GUARINI.

WHEN he first began his investigations, Marconi was by no means imbued with the idea of telegraphing without wires. All that he was seeking to accomplish was to improve Hertz's system of sending and receiving waves.

The apparatus which Hertz employed (Fig. 1) consisted of a plate-oscillator and a hoop-like resonator (Fig. 2). Marconi improved the simple apparatus thus constituted by employing a more sensitive receiver, namely, the coherer. Hertz relied upon undulatory energy to actuate his receiver directly, so that he was enabled to observe wave effects which, as Turpain has proven, may also be detected by means of a telephone (Fig. 3). Marconi utilized a relay (the coherer) which enabled him to increase the distance of transmission, the coherer being more sensitive than the ordinary resonator. We say "ordinary" because the coherer is neither more nor less than a resonator, or a condenser which can be charged, and the iron filings of which constitute the coating, and the layer of oxide the dielectric. The Hertz resonator is itself a relay, which fact can be proven by means of a very simple experiment. By energizing a powerful oscillator placed in proximity to a circuit including an incandescent lamp, eight accumulator cells, and two carbon cylinders separated by 1 millimeter (Fig. 4), the lamp can be made to glow. The conducting spark which leaps the gap between the two cylinders of carbon of the resonator, closes the circuit of the accumulators so that the lamp is made to glow.

Fig. 1. *Fig. 2.* *Fig. 3.*

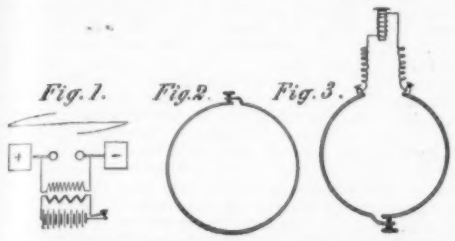
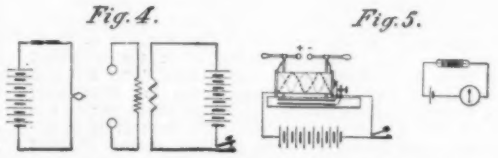


Fig. 4. *Fig. 5.*



According to one theory, the passage of a current through a coherer by reason of the influence of the waves, is due to the conductivity of microscopic sparks which pass between the individual particles of the iron filings. In its original, crude form, Marconi's apparatus, therefore, be used for actual telegraphic communication, it was necessary to impart this shock automatically. By the employment of automatic means Marconi's apparatus assumed a practical form.

For the transmitter he borrowed Hertz's resonator (Fig. 1); for the receiver he employed a coherer provided with resonating plates which conformed with those of the transmitter, and which were decohered automatically by means of an electro-magnet, operated by the battery of the coherer, either directly or indirectly, through the medium of the relay (Fig. 6).

The receiving apparatus which we have described bears considerable resemblance, by reason of its decohering devices, to that with which Popoff, in 1895, experimented in Russia. It is not here intended to imply that Marconi simply adopted the work of the Russian scientist. When Marconi applied his apparatus to telegraphic communication, the conception of an automatic decoherer came to him naturally and was without any difficulty embodied in a practical form.

Following the example of Hertz, Marconi utilized reflectors (Fig. 7). The devices illustrated in Figs. 1 and 6 should be considered for a moment, for by their means syntonic telegraphy has been at least partially realized.

What is syntonization? In order to answer this question fully, it will be necessary to explain a few physical principles. If "stationary" waves are sent through a conductor, at certain points the tension will be zero (these points being called nodes), and at others the tension oscillates from zero to a certain value which exceeds that of all other points. These points of greatest amplitude are called loops (Fig. 8). The greatest difference of potential is to be found between two points corresponding to two loops (of the tension) of contrary signs. In the resonator, the greater the difference of potential the greater will be the length of the spark. If the resonator be regulated so that it will operate (that is to say, produce sparks), only with this difference of potential, it is evident that it will not operate if it is placed between any two other points whatever. This property of stationary waves in wires has been utilized to show that the explosive distance in a Hertz resonator brought in an ordinary field (Fig. 9) is zero between two nodes or two loops of the same sign, and maximum between two loops of contrary signs. As it will hereafter be shown, we have here, to a certain extent, a means of sending messages with secrecy.

As pictured in Figs. 1 and 6, the coherer is placed between two loops of contrary signs, the plates of each apparatus (plates which we suppose to be of the same size) being placed opposite each other. As Tommasina has proven (Fig. 10), if the effluvium or the lines of electric force be perpendicular to the radiating surface, a certain control of direction (orientation, Fig. 11) is indispensable, as we have already remarked, to establish communication at great distances. In practice it is difficult to realize this condition. The difficulty is still further increased if the stations be movable, as they are when located on board ship.

Fig. 6. *Fig. 7.* *Fig. 8.* *Fig. 9.* *Fig. 12.*

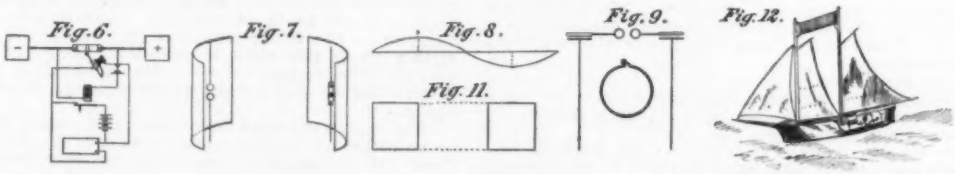
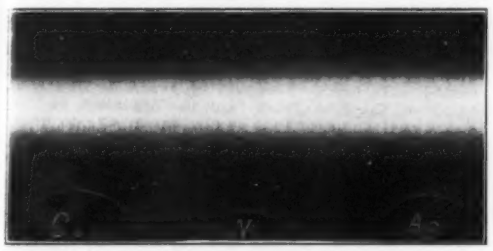


Fig. 11.

Fig. 13.

EDISON'S CAPTIVE BALLOON.

FIG. 10.—TOMMASINA'S EXPERIMENT.



us practically applied, as did also Branly's apparatus of 1890, the discovery made by Hughes in 1879 of the influence of a variable current on imperfect contacts, and above all the observations made in 1885 by Calzecchi Onesti, on the change in conductivity in the metallic filings when they are included in a circuit having a sufficient tension. In Calzecchi's experiment, the current employed was an induced current.

Marconi's first apparatus (Fig. 5) included a source of current actuating an oscillator by means of a Ruhmkorff coil. This oscillator influenced the coherer, included in the circuit of a battery, and a receiver. By means of the apparatus thus constituted effects at great distances could not be obtained, because the transmitter and receiver were imperfect.

Let us first consider the transmitter. In the first place, the transmitter could not produce ethereal perturbations to a considerable distance, because it did not possess any means of concentrating the waves, and because the radiation was spherical. In the second place, the electric field had little or no influence on the coherer, for the reason that the two positive and negative poles acted each with equal intensity. The difference between the induced electrostatic charges depended on the difference between the distance separating the coherer circuit from each of the transmitter poles. The electro-magnetic field of the coils had almost no effect on the circuit of the coherer, because the two parts of each coil acted with contrary and almost equal forces.

In this arrangement the variable magnetic field of the core of the coil generated an induced current capable of affecting the coherer. This magnetic field could act directly on the filings if they were magnetic, as in the first magnetic coherers of Tissot, Rochefort, and Cervera.

The receiver, it should be observed, exposed too little surface to the waves. The circuit hardly lent itself either to electro-static or to electro-dynamic induction. Once impressed the coherer regained its resistance only by a shock. In order that the Hertzian waves might,

On the other hand, if the lines of electric force are not propagated perpendicularly to the radiating surface, communication through great distances will be equally impossible, because each plate of the transmitter will act with an intensity, almost equal and contrary, on each plate of the receiver; hence the necessity of modifying the Marconi apparatus. The first change, affecting both the transmitter and receiver, was the suppression of one of the plates for the purpose of avoiding contrary effects which might be produced. If, furthermore, the apparatus be transformed in such a manner that besides electrostatic induction, electro-magnetic induction is possible, their power of transmission would be very considerably increased.

In December, 1891, Thomas A. Edison took out a patent in the United States which bears the number 465,971, in which he claimed an improved wireless telegraphic apparatus adapted for use both on land and on sea. This apparatus (Fig. 12) was constituted as follows:

1. In the transmitting apparatus, one end of the secondary winding of an induction coil was grounded and the other end connected with a wire, arranged at a considerable height and connected with a metal plate.

2. The receiving apparatus comprised a telephone circuit connected with the receiver in the same manner. Since obstacles might be interposed between stations in communication, Edison resorted to captive balloons (Fig. 13). As the inventor states in his patent, the arrangement may be regarded as a condenser, in which the plates or wires constitute the coating, and the air the dielectric. But in order that this may be so, the earth should have acted as a circuit-completing conductor, which was not the case.

Fig. 14.

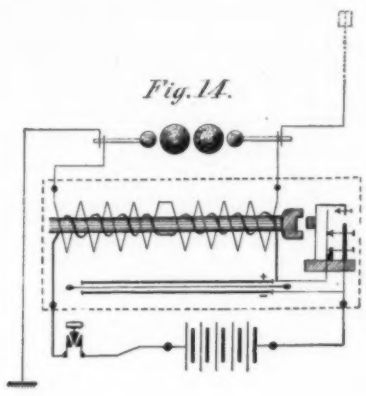
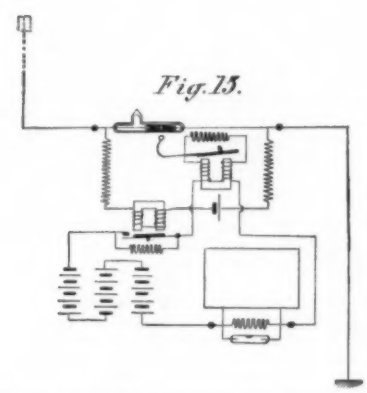


Fig. 15.



MARCONI'S MODIFICATION OF THE EDISON AND PREECE SYSTEMS.

Edison's arrangement gave rise not so much to electrostatic induction as to an electro-dynamic induction.

Another fact of great importance should here be mentioned. In 1885 telephonic conversation could be carried on at a distance of 7,000 feet between two parallel wires of the London system. When it is considered how feeble is the energy of a telephonic transmitter and how great that of an oscillator at the moment of discharge, some idea will easily be gained of the powerful effect produced between two parallel wires, the one connected with an oscillator, the other with a telephone (as in the case of Edison's apparatus), or with a coherer (as in the apparatus of Popoff). Two means suggested themselves of avoiding inevitable contrary effects, caused by the double conductors to each of the stations.

The first of these was to employ (Edison's method) an open circuit, in which the energy is the product of the capacity by the frequency. The second method is to close the circuit through the earth (Preece's system), in which case it should be remarked that the earth does not act as a conductor. Marconi modified these various apparatus with considerable ingenuity (Figs. 14 and 15). He adopted Edison's transmitter, added a four-ball Righi oscillator, connected with the terminals of the secondary winding of an induction coil. He borrowed Popoff's receiver, and added a capacity. He also made many improvements which are of considerable importance in practice, such as shunts, choking-coils, and the like. It is probable that Marconi knew nothing of the work of his predecessors; as he himself said at a meeting of a scientific society in London, it was chance that led him to employ vertical wires and antennæ. It was by means of the apparatus which we have described that Marconi succeeded in transmitting messages at Bristol between Penart and Weston in May, 1897, for a distance of 15 kilometers (9.3 miles).

(To be continued.)

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

SALT AND ITS PHYSIOLOGICAL USES.*

By M. A. DASTRE.

SALT is a universal commodity. It seems to have been used almost without exception in all places, times, and civilizations. To-day it seasons the wretched meal of the Soudan negro and the carefully selected repast of a European table. We find the same predilection for its use as far back in history as we can go. The Jews offered it to Jehovah with the first fruits of the harvest and the fruits of the earth; Homer calls it divine and chronicles its use in the repasts of his heroes; Tacitus tells of furious wars between the Germanic tribes for the possession of salt springs near their territories.

Indeed, men have recoiled before no hardship, no sacrifice, and no danger to procure this precious substance. They have sought to obtain it by war, by fraud, by the fatigue of long journeys. Some very primitive peoples have been remarkably ingenious in methods of procuring it for their own use; for example, the aborigines of the Sunda Islands have invented rude chemical processes for extracting it from the mud about their mangrove trees. Mungo Park saw the inhabitants of the coast of Sierra Leone give all that they possessed, even their wives and children, to obtain it. It is, in fact, an object of so general consumption, so necessary to man, that it affords an assured medium of exchange, and that is what is meant when we say that salt has been used and is still used for money. This is true for the different countries in central Africa. It was the same in ancient times, and, since the Roman soldier received in his ration salt as well as oil, meat, and cheese, his compensation took the name of *salary*, a name extended later to all stipulated wage for material work.

The need, the hunger for salt is not confined to man. Many animals seek this substance with avidity. Buffon wrote: "Nothing pleases the appetite of sheep more than salt." Barrall, Boussingault, and Desaive have informed us that cattle may suffer cruelly from a lack of salt, and that, on the other hand, they thrive when it is added to their ration.†

Reindeer and red and roe deer love to lick the surface of brackish puddles and saline efflorescences. In all climates, in all latitudes, wild ruminants and other hoofed animals resort to salt licks, a circumstance of which hunters take advantage, choosing their shootin,; covers either where salt naturally effloresces or where they themselves have scattered it.

A predilection so general and an appetite so imperative cannot be considered as mere accidents. They doubtless correspond to a natural need of the system. Modern physiology has attempted to discover the reason for their existence which must be profoundly based in the animal organization. It has asked why, among the mineral substances that form a part of our food, some of which enter much more extensively into the constitution of our tissues, common salt should be the only one that man artificially adds to his natural aliment. The salts of lime and the phosphate of soda, for example, which compose so large a part of the skeleton or of the liquids of our economy, are not used at all in cookery. If we sometimes use them in an isolated state it is merely as medicines. What is the reason for this instinctive and peculiar employment of common salt over and above the quantity naturally contained in foods? This brings up the more general question of the part which salt plays when once introduced into the organism; of the physiological phenomena in which it participates; in a word, of the evolution which it undergoes. . . .

I.

Salt was first used as an aliment at the time of transition from the pastoral and nomadic stage to sedentary and agricultural life. The Indo-European languages have no common word to designate salt, nor have they any for the greater number of the objects that relate to agriculture. But, on the other hand, they have common roots for all words relating to pastoral occupations. We may see in this an indication that the primitive peoples from which our modern races sprang were separated before they abandoned a pastoral life. They did not learn the art of agriculture until later, and with it they learned the use of salt.

There are populations, ethnic groups, and castes that have never adopted it. The Egyptian priests did not salt their food. Plutarch was astonished at this strange disdain. Sallust says that the Numidians did not care for salt: *Neque salem, neque alia irritamenta gulæ quærebant.* And in the same way we see around us, side by side with animals of the farm that are very fond of it, the dog and cat that do not care for it at all.

These exceptions have been for a long time considered as inexplicable. It could not be understood how the need for salt could, in certain cases, be as imperative as true physiological needs, such as hunger and thirst, while in others it seemed entirely foreign to the organism. A learned physiologist, M. Bunge, of Basel, has thrown some light upon this obscure question. After an extensive investigation, ethnographic, historic, and geographic, he has drawn the primary conclusion that the use of salt is connected with the kind of diet. Salt is a necessary complement to a vegetarian regimen. Among animals it is the herbivora that seek it with avidity. Carnivora are indifferent to it or even regard it with disgust. Among men the appetite for this seasoning exists especially in those whose food consists of leguminous vegetables and cereals; that is to say, among agricultural populations or at least among those who live on a mixed diet. On the contrary, those who do not care for it are the pastoral tribes that live upon milk and meat that they derive from their flocks and herds, hunting tribes that subsist upon the products of the chase, and fishing populations who, although they dwell by the sea or at the mouths of rivers, where they can get plenty of salt, yet do not use it. Now, if this is really the case, we may at least consider that the correlation between these two phenomena, the development of agriculture and sedentary life on the one hand and the use of salt with the food on the other, is worthy of investigation.

All the nomadic tribes of the north of Russia and Siberia abstain from salting their food. They can readily obtain salt; for deposits, efflorescences, and salt lakes abound in those regions; still these peoples, who live by the chase and by fishing, have a decided aversion for this condiment. An explorer who lived a long time with the Kamchadales and Tunguses, the well-known mineralogist, C. von Ditmar, amused himself by inducing them to taste the salted food which he himself used and by noting the expressions and grimaces of dislike which this simple seasoning caused. This was not, however, because these people had an excessive delicacy of taste. They habitually fed upon an unnamable mixture made of fish massed in enormous silos where they putrefied at leisure awaiting the time when they should be eaten. The Russian government desired to change these too disgusting and unhealthy food habits. It taught these people the art of salting fish so as to preserve them from putrefaction, establishing for this purpose curing stations near their encampments and furnishing them with salt at nominal price. Vain efforts! These docile peoples obeyed. They salted the fish, but they ate them not.

Similar examples of indifference or antipathy to this apparently necessary seasoning are found in other latitudes. The Kirghizes of Turkestan, who live upon milk and meat in their salt steppes, do not use salt at all. The Bedouins of Arabia, according to Werde, find the use of salt ridiculous, and the Numidians, whom Sallust describes as disdaining the use of salt, fed, according to his testimony, upon milk and meat—*lacte et carne ferina.*

Africa furnishes still other examples quite as demonstrative. The Scotchman, Mungo Park, who a century ago explored the region now called the great bend of the Niger, was struck with the eagerness for salt shown by the negro agricultural populations. This was brought to them with difficulty and sold at a very high price by caravans that obtained it from Mauritania, from the sebkha of Ijil, halfway between Senegal and Morocco, or from the deposits of Taudeni north of Timbuktu. "In the interior countries," he says, "the greatest of all luxuries is salt. It would appear strange to a European to see a child suck a piece of rock-salt as if it were sugar. This, however, I have frequently seen, although, in the inland parts, the poorer class of inhabitants are so very rarely indulged with this precious article, that to say a man eats salt with his victuals, is the same as saying he is a rich man. I have myself suffered great inconvenience from the scarcity of this article. The long use of vegetable food creates so painful a longing for salt, that no words can sufficiently describe it." This is an important statement. We may compare it with an observation of an opposite character also recorded by Bunge, which completes and serves to confirm it. It relates to the astronomer, L. Schwarz, who, after living some three months with the Tunguses of Siberia on an exclusive diet of reindeer meat and game, lost the desire and the habit of adding salt to his food.

In America similar observations have been made. At the time of its discovery the greater number of the tribes of North America lived by the chase and by fishing. They used no salt, although it was very common in their prairies. A small number only were at that time sedentary and agricultural. These were fond of salt and undertook frequent wars for the possession of saline springs. Farther south, in Mexico, a sedentary people of more cultured character used salt regularly, while in the Pampas, covered with salt lakes and efflorescences, the Gauchos scorned a vegetable diet and the salt which seasoned it as food fit only for their beasts.

The examination of what has occurred in the people of the Indian archipelago and Australia supports anew the law of Bunge. Everywhere it is the populations devoted to agriculture that use salt. Everywhere, also, peoples addicted to the chase, to fishing, or to a pastoral life either disdain it or refuse to use it. Some European explorers who have, like Schwarz, adopted an animal diet have become accustomed to do without salt, while others, like Mungo Park, reduced to vegetable food only, have endured an almost painful hunger for this substance.

II.

There is, then, a well-established relation between a vegetable diet and the need for salt and reciprocally between an animal diet and the exclusion of this article from food. We must now push the matter further and ask the reason for these remarkable relations. This is the problem formulated by G. Bunge, who, as a chemist, has advanced a very ingenious theory for its solution.

The answer might be very easy. If, for example, the difference between the two diets was that of a difference in the amount of salt which they respectively contained; if the food of vegetable origin was poor in common salt and that of animal origin rich in that substance, the solution would be clear; the law empirically established by Bunge would have a very evident explanation.

But the matter is not so simple. The two kinds of diet are not distinguished from each other by the quantity of salt which they contribute to the organism. In fact, both kinds are very poor in salt.

If we examine food as it comes from plants or animals we find that the greater part of it is tasteless and insipid, insufficiently salted for our taste. The albuminoids of meat, the fats, the starch of cereals and leguminous plants, do not, by themselves alone, exercise any action upon our gustative sense. The flavor of our food comes from secondary products, from aromatics and odors that are added in some way; to be exact, from foreign substances existing in very minute quantities, ethers, acids, and essential oils that culinary preparation and cooking only develop to a greater degree. In general, natural food is but slightly saline.

Since the small quantity of common salt contained in natural aliments suffices for our needs when the diet is confined to animal food, it ought to answer for them in the case of a vegetable diet. Why is it otherwise? Whence comes it that one of these methods of alimentation requires the artificial addition of salt? Chemists have ascribed the cause of this peculiarity to the different composition of the two kinds of food. Although both contain equally small quantities of chloride of sodium, they are distinguished from each other by another mineral product which they possess in an unequal though considerable degree. This is potash. In marked contrast with common salt, this substance, always abundant, varies greatly in its relative quantity in different kinds of food. There are foods that contain a great deal of it, and these are precisely those that are taken from the vegetable kingdom. Plants are generally distinguished by their richness in potassic salts. They accumulate enormous quantities of them, drawing them from the poorest soils. Indeed, before the discovery of the mines of Stassfurt, the incineration of green plants was the only source of industrial potash. Inversely, there are other aliments derived from animals that are generally relatively poor in these compounds. In fine, the capital difference—we do not say the only one—that distinguishes in the eyes of the chemist the two modes of diet, is the abundance of potash in the vegetarian ration and its deficiency in the meat ration.

If we make a list of foods arranged according to the increasing quantity of potash which they contain, it will be seen that animal substances (blood, milk, meat) stand at the head, while lowest are vegetables (beans, strawberries, potatoes, clover). Still, there are some remarkable exceptions. Rice, for example, is very poor in potash, a kilogramme of rice in a dry state furnishing only a gramme. It is true that it furnishes still less soda (33 times less). In this respect a rice diet approaches an animal diet; and, in fact, provokes but a slight appetite for salt. On the contrary, a kilogramme of potatoes contains 24 grammes of potash and 60 times less of soda. This food approaches, from this point of view, the vegetarian type in its perfection.

The information given us by chemical analysis may then be succinctly stated as follows: The vegetable kingdom furnishes the economy with much potash and very little soda—about 25 to 150 times more potash than soda. On the other hand, the animal kingdom reduces the supply of potash without reducing in the same degree the supply of soda. It introduces into the economy no more than 2 to 5 times as much potash as soda.

All this is perfectly true and interesting in itself, but it may be asked what it has to do with the question we are considering, and what hidden relation there is between the proportion of potash that distinguishes the two diets and the inequality in the need for salt which they produce. M. Bunge believes that he has discovered this relation. His hypothesis is that potash is responsible for our like or dislike of salt in cookery. This he justifies by a series of closely connected inductions. The need for salt is the consequence of the loss of salt from the organism, as thirst is the consequence of the loss of water due to hemorrhage, transpiration, or other causes. The need for salt implies a previous loss of salt. Secondly, the loss of salt should be a phenomenon of a chemical nature resulting from reactions of disintegration. Thirdly, this chemical phenomenon having, as is proved by experiment, a relation to the different kinds of diet, should be caused by their chemical characteristics—that is to say, by the difference in their proportions of potash. That is his doctrine. Theory having led him to this point, the rest is a simple matter for the clever chemist of Basel; he has no difficulty in discovering the mechanism by which the vibrations of the potash introduced into the system control the proportion of salt that is eliminated.

When a theorist declares that something *should* be, he usually suspects that it *may* be otherwise; this occurs twice in the reasoning which we have just cited. Hence, there are two weak links in the chain of argument. Therefore the principle of this theory is uncertain and may be contested. Indeed, it has been.

It is possible, contrary to the reasoning of Bunge, to increase the relative and absolute quantity of potash taken into the system without increasing the appetite for salt; indeed, we may even decrease the desire for it.

An example of this sort is found among the negro tribes of Africa who use "*ash salt.*" The use of this mineral condiment extends throughout a large part of Central Africa in the basins of the Ogove and Sanga north of the Congo and in the provinces of the Free State to the south on the opposite side of the river. The lack of sea salt or rock salt causes these populations to replace this substance by another saline material which they prepare on the spot by their own means.

But this is not ordinary salt—chloride of sodium; it is not even a soda salt. They obtain this spurious salt from the ashes of plants. Not the first that come to hand, for it is not immaterial what plants are chosen for this purpose. On the contrary, they are carefully selected species. They use particularly two plants from the river. The favorite one is a floating aroid common on the Ogove and determined by M. Lecomte as the *Pistia stratiotes.* It is said that at certain places this plant is cultivated solely for the purpose of extracting its salt. The second is a sort of high bamboo that grows in clumps upon inundated banks.

What peculiarity have these plants that causes them to be chosen to the exclusion of others? We do not know. M. L. Lapicque, from whom we have derived a part of this information, supposes that it is the slight proportion of carbonates that they furnish when incinerated, or as the effect of subsequent treatment. In a product destined for food, the lack of alkaline carbonates is a decided advantage, for their nauseous odor and alkaline taste is repulsive to all.

After being harvested the plants are dried and then burned; the ashes are collected and leached. At Berberati, on the Upper Sanga, Dr. Herr witnessed this process. The aborigines use for this purpose a rude filter made of a conical basket, in which the ashes are placed. Through this water is passed and repassed several times to dissolve out all the soluble salts. The

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* Translated and condensed in Smithsonian Report for 1901, from the Revue des Deux Mondes for 1901, Vol. I, pp. 197-227.

† In practical agriculture it is generally admitted that there should be given to each sheep about 2 to 5 grammes of salt per day, 30 to 50 grammes to a horse, 60 to 100 grammes to an ox. In England and in Germany stock raisers much exceed these amounts.

solution thus obtained is then evaporated by heat. The fixed residue forms the "*ash salt*."

The composition of this salt, at least as to its general features, is well known. M. Dybowski, in 1893, communicated to the Academy of Sciences some analyses of it. Its composition varies little from that furnished by most plants similarly treated. Normally, as has been already said, potash is greatly in excess of soda in all vegetables. The proportion varies from 30 to 150 parts of potash to 1 of soda. That is what we find in this case; the quantity of soda is very minute. The characteristic features of the chemical composition of these plants would then be an abundance of chloride of potassium and a scarcity of carbonates.

This spurious salt tastes much like common salt, but leaves the sharp after-taste of potassic salts. It is not, on the whole, decidedly disagreeable to a European palate; the aborigines prefer it to common salt.

The strong appetite which these sedentary, agricultural negroes have for this mineral condiment quite justifies the rule established by Bunge, according to which the need for salt is connected with agricultural habits and vegetable diet. And if this appetite is manifested here not only for true common salt but for a sort of spurious salt, the law is still better exemplified. Bunge goes so far as to say that in this case observance of the law is carried even to aberration, but, on the other hand, it will be readily seen that the theory devised by the chemist of Basle to explain his rule is undermined by this very example, for this need for salt being due, according to him, to the waste of chloride of sodium from the organism, which, in its turn, is indirectly caused by an excess of potash in the food, should only be remedied by restoring the lost chloride. But in this case the ash salt that appeases and satisfies the need is a salt of potash, and so ought, theoretically, to exasperate it.

The explanation of Bunge is therefore not tenable. All that experience teaches is that an exclusive vegetable diet causes a need, a particular appetite, which can be satisfied by substances having the taste of cooking salt and containing either chloride of sodium or chloride of potassium. In brief, from a chemical point of view, it is a need for chlorides; from a physiological point, a need for salty savor; that is to say, for a particular kind of gustative sensation.

III.

One of the effects of the progress of civilization has been to substitute a mixed diet for that of primitive people, this latter being sometimes exclusively animal, at others exclusively vegetable. At the same time the use of salt has become general and is now a universal habit, but we have just seen that its use was originally limited to vegetarian peoples and had its origin in a need either for a material constituent of the body or for a sensation.

Which of these two alternatives is the true one? Must we admit, with Bunge, that we have a true chemical need, an appeal, an attraction of the organism for a substance necessary for its constitution and, at the time, deficient? Is it not, rather, merely a need of the senses, a sort of protest of sense against the habitual tastelessness of vegetable foods which has to be remedied by a condiment otherwise inoffensive?

This is the conclusion of the greater number of physiologists. It is that of M. Lapicque, who sees, in the appetite for salt, a particular case of a very general taste for condiments common to all populations that live on vegetables: To the Abyssinians, who counteract with *berberi*, a sauce spiced with pimento, the insipidity of their durrha or Indian millet; to the Hindoos and Malays, who mask with curry the tastelessness of rice, the basis of their diet. This is also the opinion, of far greater antiquity, of Sallust, who, speaking of the salt disdained by the Numidians, ranks it among the *alia irritamenta gulæ*.

In reality, one may reconcile these opinions and bring Bunge into agreement with Sallust and M. Lapicque. The sole function of condiments is not that of rendering agreeable the enforced task of eating and of transferring into a pleasure the necessity for food. The gustatory sensation is not wholly for the pleasure it gives; it is charged with an important function relating to the operations of the digestive apparatus. As Prof. Pawlow and his pupils have recently shown, it starts into action the vital energy of the stomach and induces the secretion of an efficient gastric juice, rich both in acid and in ferment (pepsin). Even the contact of the food with the mucous membrane of the stomach, which physiologists have until recently supposed to be the only means of arousing the secretion of that organ, does not have as much effect as the sensory excitation due to sapid substances. The gustatory impression is more efficacious. It causes a more abundant secretion of gastric juice, which is more energetic in its action and therefore of greater value.

Condiments and seasonings are therefore found to have a justification that is to some degree of a physiological character. They insure the proper action of the stomach.

Salt does more. At the same time that it puts in motion the secretion of the stomach it furnishes it with materials, at least with some of them. Hydrochloric acid, which is characteristic of the gastric juice and insures its digestive efficacy, is derived from salt, from the chloride of sodium of the blood. The same origin should be ascribed to the chlorine compounds found in the juices of the stomach, fixed chlorides and organic chlorine. In other terms the material for the chlorine compounds of the gastric juice comes primitively from the salt of our food.

This is not the place to discuss how, in order to produce this result, the salt of the blood is decomposed within the gastric glands. This is a problem that has greatly occupied modern physiological chemists, and upon which they as yet do not fully agree. Maly has supposed one kind of mechanism for this reaction, Laudwehr another. The method matters little. That which should be noted is the fact that salt is destroyed by gastric digestion, and that the equilibrium of the organism demands that it be replaced. If, then, the loss of salt is not, as Bunge supposes, the primary cause for the need of salt so general among all peoples, it is at least its consequence and its physiological justification.

Any other chloride than that of sodium susceptible of introduction into the blood may there participate in similar reactions and play the same part.

The ash salt, rich in chloride of potassium, is a good substitute for cooking salt. Recent experiments have led MM. Dastre and Frouin to conclude that chloride of magnesium may be used for the same purpose with still more striking results. The secretion of gastric juice, which increases in quality by the introduction of common salt into the blood, is still more increased by the introduction of the magnesium salt.

The same result would be obtained by the introduction of the spurious ash salt prepared by the negroes of the Ogove and the Sanga as by the use of common salt; still better results by the magnesium salts if other reasons did not exclude their employment. In the absence of salts belonging to the same group as common salt we may even substitute, as has been shown by the well-known chemist, E. Külz, others farther removed, such as the alkaline iodides and bromides. These give rise to a gastric juice acidified by hydriodic and hydrobromic acid instead of by hydrochloric acid as is normal gastric juice. Still, if such a substitution in no way affected the functions of the stomach, it might not be the same in relation to other organs.

IV.

Ordinary salt, the chloride of sodium, is one of the constituent elements of animal organisms, existing everywhere in them. The blood has a saline taste more or less marked; all the secretions are salty; the tears themselves are more salty than bitter, whatever good people may say about them. Salt water, in fact, bathes all living particles and leaches continually from the organic structure, escaping from all its tissues, carrying with it the waste matters which should be rejected from the body.

Common salt is more suitable than any other for this purpose. In a dose of 9 grammes per 1,000 it forms a solution innocuous to the anatomical elements, that can circulate around the most delicate of them without causing the least damage. This close association with salt has become habitual to them from immemorial usage; they have adapted themselves to it, and it would lead to some inconvenience if another mineral constituent should be too abruptly substituted for it. In certain animals that have been bled to exhaustion, life may be kept up for some time if the blood is replaced by a saline solution, named, because of its properties, the physiological solution. A turtle or a frog in whose veins this fluid circulates continues to live for a considerable time. Certainly this is not a generous liquor; the living alimentary particles find in it nothing by which they can be nourished and sustained, and they can live in it only as long as their own reserves may last, but at least it does them no harm.*

We may now begin to comprehend what becomes of the salt we consume in obedience to the curious need of which we have spoken. It is easy to predict its destiny. The greater part of it will remain in simple solution; the remainder will enter into combination, more or less intimate, with living matters. The former will penetrate into the circulating liquids, lymph and blood, and will with them pass through all the systems of the body without taking any direct part in the vital changes, but, on the contrary, act merely as a filling, neutralizing by the number of its molecules the danger which the cellular community would incur if the medium in which it lives were too much diluted, and it will finally pass out by the natural emunctories, invariable, unchanged, but having performed the service of removing from the economy the effete products of cell life. This eliminated salt must be replaced. Its loss, reacting upon the organism, is the primary cause of the need for salt.

The second and smaller portion of the salt taken into the body will penetrate into the elements themselves, will make an integral part of them, will participate in their chemical changes, not only those which give rise to the gastric juice, but also others, finally becoming destroyed and lost to the organism. The void left by this continual elimination has doubtless some weight in the sensation of need for salt, which the animal feels. It is a second element of it.

V.

The necessity for common salt in the food results from this series of changes. The organism could not be maintained, or, in other words, health would be impaired if that which was lost were not restored. Mineral aliments are therefore a necessity. It is necessary that we should have salt. There are some physiological functions in which common salt may be replaced by another, as we have seen in the case of the gastric secretion, but there are others for which such substitution is, probably, impossible. A modicum of chloride of sodium is indispensable to life.

In truth neither men nor animals have to occupy themselves in finding this modicum. It is exceeded by the quantities normally existing in natural foods. The difficulty, then, is not in obtaining the nutritive substances which contain this modicum; it would rather be in devising a food sufficient in other respects, that is to say, as regards nitrogenous, fatty, and starchy matters, in which this modicum did not exist.

Nevertheless a physiologist, Forster, in 1864, was able to do this. He utilized the waste from meat powder derived from the manufacture of Liebig's extract, treating it several times with boiling water, so as to wash away almost all the soluble salts. With this leached meat, together with starch and fat, he formed a ration in which there was wanting nothing but the mineral salts.†

Animals nourished with this ration in reality suffered from mineral inanition. The experiment of Forster, carried out at Munich under the direction of Voit, is, in fact, a typical one of this kind and perhaps the only one performed until latterly, when Bunge and other physiologists took up the matter again.

The necessity for mineral alimentation was affirmed as a general principle as early as 1861 by Liebig in his Letters on Chemistry. It is true that Chossat and Boussingault had called attention to the necessity for lime and that Becquerel and Rodier had spoken of the need for iron; but these were only special studies. Liebig stated the general principle; animals require for their proper maintenance albumenoids, fats, either starches or sugars, and mineral aliments; but it was not Liebig who demonstrated this, it was Forster.

In fact, the experiment of Forster relates to the entire sum of mineral matters, not specially to the chloride of sodium. It is an example of complete *mineral* inanition, not of *saline* inanition. It furnishes, however, some information as to the consequences which may follow from the suppression of salt in alimentation. As soon as the regimen was established, the animal showed a considerable diminution in the quantity of salt rejected by the emunctories, though the urea and the organic waste products maintained their usual proportion. The organism, then, retained its mineral matters; the mutations of chloride of sodium engaged in organic combinations were slight. After twenty-six days of this method of alimentation the animal had lost but 7 grammes of this chloride of sodium in combination. Its health, however, was much impaired. It grew more feeble day by day. Nervous troubles appeared, consisting at first of habitual inertia, paralysis of the limbs, and later of convulsive seizures and attacks of madness. The gastric secretion diminished at once. Toward the last it no longer contained hydrochloric acid. Grave digestive disturbances finally intervened. The animal, however, lost but little in flesh; its pining away, its corporeal and physical failure, was but the result of the suppression of mineral salts. The lack of common salt was, doubtless, but a single factor in the production of these phenomena. The absence of other salts, particularly of the phosphates, had also something to do with it. Nevertheless, it is striking to see what violent disturbances may result from slight variations. In fact, the animal succumbed more quickly from the deprivation of mineral elements alone than it would have done from total inanition, that is to say, from the suppression of all aliments except water.

The necessity for a modicum of common salt is shown by these experiments. Chloride of sodium is then a plastic aliment. It is placed by Munk and Ewald in the category of nutritive salts together with the alkaline and earthy phosphates and the salts of iron. According to statistical data the daily consumption of salt in Europe is on the average 17 grammes per capita. Of these about 2 grammes are necessary to cover the loss by disassimilation. These two grammes represent *nutritive* salts. The remaining 15 grammes would then represent on the one hand 8 to 10 grammes carried away by excretions and necessary for restoring the constitution of the circulating liquids, and a surplus; but, considering the influence of salt upon the secretions, it would not be prudent to say that this surplus is a sacrifice made to the pleasures of appetite.

We have just seen the ill effects of a deprivation of salt. We should perhaps say a word about those which result from its excessive use. It is known that if taken in amounts beyond the average it causes thirst, and an increase in the renal excretion. It has been shown that this increase remains about the same whether or not the subject drinks. The water excreted is then taken from the tissues.

If the absorption is pushed beyond moderate quantities, vomitings and intestinal disturbances ensue. This kind of excess has rarely been observed unless we regard as authentic the story of those midshipmen who are said to have been compelled by Peter the Great to drink sea water for the purpose of inuring them to a sailor's life and who died as a consequence.

VI.

Besides taking an active part in certain of the vital phenomena, common salt fulfills better than any other substance the conditions of a medium that is indifferent and yet suitable for the physiological necessities of living matter. In animals as well as in plants, in the mobile corpuscles of the blood as well as in the fixed elements of the tissues, living protoplasm is always rich in potassic salts. The interior medium which bathes it abounds, however, in sodic salts, particularly the chloride of sodium, resembling in this respect sea water, which might, if properly diluted, circulate in the veins and replace for a time the plasma of the blood, as we have seen may be done with the physiological solution. Some naturalists, recalling the circumstances under which life appeared on the globe, and the manner in which it was for a long time maintained in the saline waters of the Palæozoic seas, have thought they perceived in this fact the survival of an ancestral condition.

From this point of view chloride of sodium would be an element handed down from remote times, belonging to a medium suitable to animal life, to the blood and to the organic humors; and salted food, by introducing it about the anatomical elements of the body, would recall the marine origin of animal life, would connect, as one may say, the physiology of the present with that of the past. . . .

* A solution of this character, having the proportions of about 6 parts of chemically pure sodium chloride to 1,000 parts of distilled water, rendered aseptic and warmed to 100 deg. F., is in common use in surgery and medicine, being known as the "normal salt solution." Readers will doubtless recall that it was used in the lamentable case of President McKinley, both for the cleansing of the abdominal cavity during the surgical operation and later as a hypodermatic injection. It was also used some months before with good effect in the treatment of Mrs. McKinley, who was suffering from a disorder that had drained the blood of its fluid.—Translator.

† There remained but eight-tenths per cent of the dry weight.

CROSSING THE STREET.

"I NEVER cross the street in front of any approaching vehicle except an omnibus; it is the only vehicle I can trust to pull up and not go over my body if I should fall." This is the remark quoted by a writer in the Lancet, who overheard it in the crowded Strand of London. It may be true of London. It certainly is not true of New York. At all events the Lancet's comments on the matter are not without interest. Why are not all vehicles supplied with powerful brakes as all omnibuses are, it asks? We have seen a horse and cart coming full tilt out of a side street, the driver being quite unable to pull the horse up and avoid a collision "amidships" with another vehicle, simply because his vehicle was without a brake. It is surprising what a number of vans pass through London streets

absolutely unprovided with brakes, and we cannot see why the adoption of brakes should not be enforced even on two-wheeled vehicles. The hansom cab is probably the fastest horse-drawn vehicle in London, and yet it is never fitted with a brake, and the effort of both horse and driver to pull up on an emergency arising are pitiable from their abject hopelessness. "Knocked down by a hansom cab" is, unfortunately, a familiar enough phrase. Motors, of course, have brakes to check the onward course of the cars when necessary, and that other vehicles should not have this provision seems anomalous. One of the great difficulties of getting about London on foot is crossing the busy streets. It is only at certain points—and these are generally remote from each other—that any assistance is given by the police who, in controlling the vehicular traffic, at the same time help the pedestrian to cross in safety. It seems to us that at complicated crossings a system of arm signaling after the method adopted on railways might be employed with advantage, and one man could easily work four ways aided by his levers in a signal box actuating arms. At intermediate points the adoption of brakes on all vehicles would make crossing the streets safer than is at present the case.

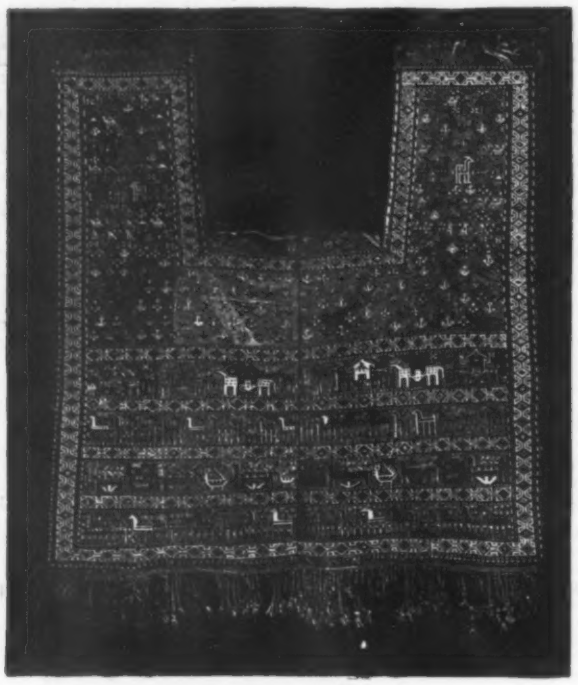
THE RUG INDUSTRY OF THE CAUCASUS AND OF THE TRANSCASPIAN COUNTRIES.

ONLY those who have lived in the Orient for some time can fully understand why the Oriental so ardently desires to own as many and as handsome rugs as possible. To most peoples of Western and Central Asia the rug is an indispensable companion through life; they need it at home as well as when traveling; it serves them as a couch, as a portmanteau; they kneel on it when praying; in short, the rug is part and parcel of life in the Orient.

It would be difficult to answer the question as to the age of rug weaving in the Orient, but it is certainly much older than a thousand years, and has in the course of time passed through the most varying stages in intimate relation to the history of civilization. Originally forming a simple ground covering in the field and in the traveling cart of the nomad, the rug gradually changed into a work of art, whose value was appreciated far beyond the borders of its place of production. The fact that there are still in existence at the present time rugs from the sixth and seventh centuries, some of which, by the way, are estimated at several million marks, shows the high state of development of rug weaving in olden times.

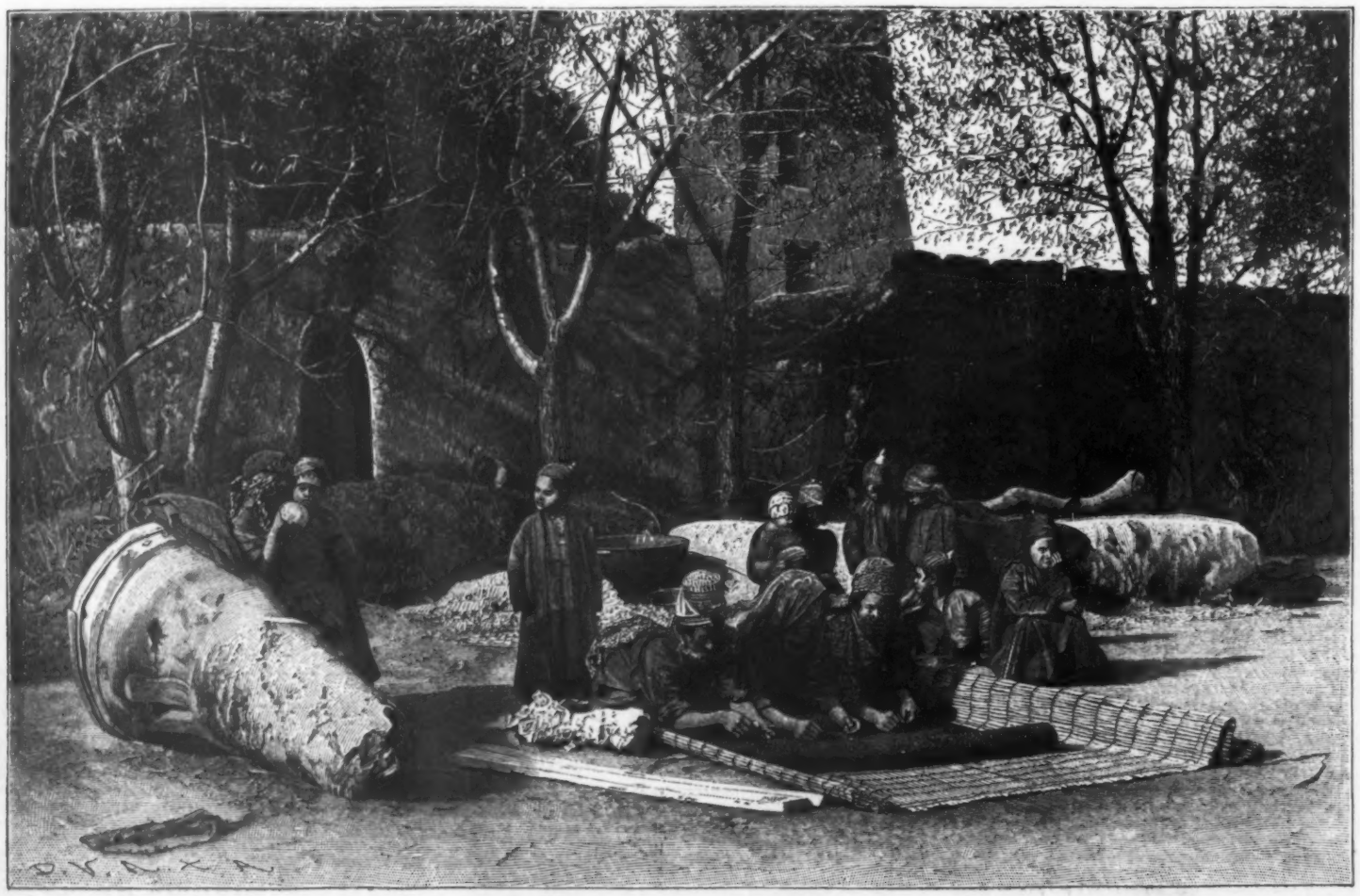
Generally speaking, the Oriental rug industry may be divided into five main groups. The Persian, that of Middle Asia, the Caucasian, that of Asia Minor, and the East Indian. Only the first-named groups will be considered here. Initially we would mention that, latterly, a sort of amalgamation has taken place, at least in some places, between the Persian and Caucasian industries, but it is still possible to recognize the Persian or Caucasian character in the design and the workmanship. In judging of Oriental rugs, a sharp line should be drawn between the antique rug and the modern one, for the Oriental has ever been known to adapt himself to the taste of his customers, and the rugs produced in the Orient at the time of the Roman emperors conformed to the taste prevailing at that time as fully as they do to-day in regard to the modern Occident.

From olden times there have been two ways of making these rugs, viz., by weaving and by knotting or tying; but it is always hand work, executed by women, and in very rare cases by men. Especially the latter style of rug making has been adopted by the Occident,



CAUCASIAN HORSE BLANKET.

RUG DEALER FROM KURDISTAN.



TURKOMAN WOMEN CLEANING A RUG.

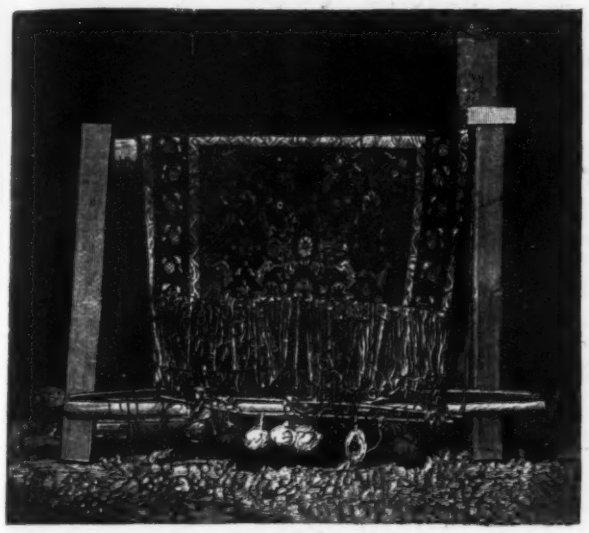
and to-day there are in Europe several factories which turn out exceedingly handsome rugs, knotted or tied in Oriental fashion, although the originals have not yet been equaled. The soul of the Oriental rug is the design; in it lies a legend, a fairy tale, which is given expression by the hand of the tent women on the loom. All the wife of the Oriental can do is rug weaving, and the more adept she is in this work, the more she is prized by her husband. It occurs that Persians and Turkomans will pay for old and homely women a price for which they could have bought three young and pretty women, merely on account of their skill in rug weaving.

The nomad woman bleaches the wool by the aid of the sun, cleanses it with grape juice, and mordants it with alum. With the exception of acetate and sulphate of iron, which are used as a black dye, vegetable yestuffs, such as indigo, madder, carthamine, Java wood (an East Indian red-colored wood of *Cæsalpinia sappan*), Avignon berries, etc., are exclusively employed. For the last few years, it is true, aniline colors are also made use of, but the Oriental only has recourse to them when the demand for rugs is so great that he cannot lose much time. The dyeing method of the nomad woman is a secret which has been preserved as such through all the generations down to the present day; nevertheless, it might be possible to explore the art, but what would be the use, since the inhabitants of the West lack the ornamental "language" which enables the Persian or Turkoman woman to embellish her rugs with an incredible profusion of *motifs*.

The Persian rug is the king of all Oriental rugs, for it shows a variety of design and weave as no other. Teheran, Khorassan, Kurdistan, Kashkai, and Kirman furnish the names for the best-known rugs; each of them has a distinct character of its own and occurs in certain variations, offering a profusion and well-nigh inconceivable splendor of ornamentation. Dedicated to domestic use of the Persians, Tartars, Caucasians, and Turkomans is the simple "palass." On it sleeps, prays, and rides the owner, and from it he makes his saddlebags, trunks, and wagon covers; in short, the "palass" is to him an inseparable companion on life's journey. The rug knotted by the Kurd mountain women is, by virtue of its dainty pattern and fineness of tying, a veritable masterpiece of Oriental rug working. The Kurd rug has 7,000 to 8,000 pile-meshes to the square meter, and the coloring is fast and the work genuine, although the designs show a decided leaning to the Oriental taste. The Kirman is one of the most expensive rugs, and forms an exception in that it is produced on horizontal looms by men. In the Caucasus it is especially the wild, brigandish Daghestan which furnishes the handsomest and most magnificent rugs, and it must be admitted that the Caucasian rugs have preserved their original character most of all, for these wild mountaineers are conservative people. The thin glossy "Shirvan," the figured "Sumakh," the "Daghestan," all have a distinct weave of their own, but characteristic of all is the brownish-red ornament of the "running dog."

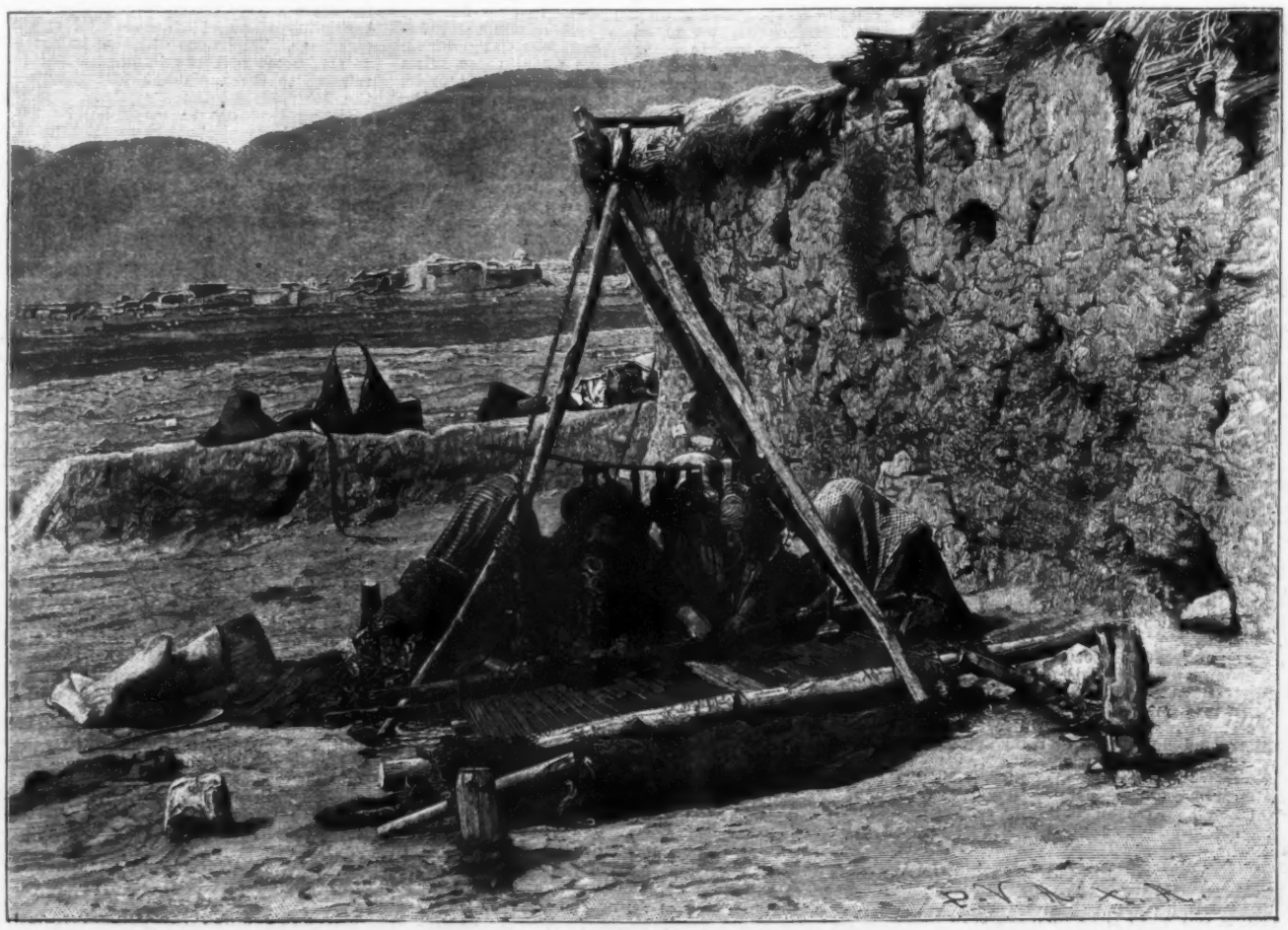
The Turkoman rug, as regards material and workmanship, takes a high place, although it does not excel in any way respecting design and coloring. In a general way all rugs of Upper Asia are comprised in Europe under the name of "Bokhara," but they should be strictly distinguished according to the tribes whose women weave them. In the front rank is the rug of the Teke-Turkoman, which is so singularly powerful in ornamentation, so firm in texture, that it must be classed among the very best rugs.

Many fine rugs are to be had in the Orient, but buying is not such a simple matter as it may seem. Aside from the fact that much experience and expert knowledge is required to estimate the value of a rug, the Oriental dealers understand most thoroughly how to confuse the eye of the buyer. By a quick succession of the pieces laid before him, they keep him from judging the details to such an extent that often he will finally buy a rug which he would not have taken under normal conditions. Whoever wants to buy rugs in the Orient must above all have time enough to sit, if necessary, for hours in the dealer's place, to sip tea very phlegmatically, and smoke tobacco, and only now and then have him lay aside an especially handsome piece from among the number of rugs shown. After quite an interval, during which the eye has been allowed to rest, the handsomest ones are selected from the rugs picked out. In a Persian rug one should make sure that it has no folds and thick parts and that the pile-cord and the knotting are even, which can be ascertained on the reverse side. The corners must fit in the pattern, otherwise the rug is worth thirty per cent less. Never bid more than one-third of the price asked, and after long haggling give about one-half. It is also important not to let the dealer notice that one has a preference for a certain piece, else he will at once ask three times the price. Residents of those parts can sometimes strike a private bargain in the



FRAME FOR KNOTTING, WITH HALF-FINISHED RUG.

PERSIAN RUG.



PERSIAN TENT WOMEN KNOTTING A RUG.

steppes of Central Asia or the mountains of the Caucasus and obtain from the natives the most costly antique pieces at a low price—pieces which after thorough cleaning have a twenty to fifty times higher value.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT, from Ueber Land und Meer.

DEATH VALLEY.*

THE MOST DESOLATE SPOT IN NORTH AMERICA—ITS HISTORY, INHABITANTS, AND PRODUCTS.

By DON MAGUIRE.

INYO and San Bernardino Counties, California, and Nye County, Nevada, taken as one united area, comprise the most utterly desert region within the area of the United States. When I state this I do not mean that all of the area above named is entirely an irreclaimable desert, but the greater part of the section is, and within its area lies what may be termed the culmination of sterility, the one spot wherein desolation is supreme, and whose name was well applied, for within no part of the known world is there another such spot as Death Valley. While I would not paint such gruesome pictures of the above region as those delivered by several lecturers, who, during the past twenty years, have, in various parts of our country, lectured before educational institutions, and who made statements I knew to be erroneous, I will, however, state that the land is weirdly desolate, and that the dreary regions of the damned are well typified in that locality during the months of June, July, August, and September of each year. Death Valley lies wholly in Inyo County, California, between degrees of north latitude 36 deg. and 37 deg., and of longitude 116 deg. and 117 deg. Like all of the great valleys of Nevada and California, Death Valley lies oblong from north to south. Its length is about 50 miles and its width from mountain range to mountain range about 35 miles, although the width of the deepest part of Death Valley is less than 30 miles.

There are three features that, taken together, have made Death Valley what it is. These are: First, the surface of the valley is about 210 feet lower than the surface of the ocean. Second, the high range of the Panamint Mountains shuts out from this deep valley the last vestige of moist winds that blow from the Pacific Ocean. These winds, even before they reach the summits of the Panamint Range on the west, have swept across the Mojave Plains and next have blown over the Panamint Desert so that what little moisture they carry is exhausted before they roll across the Panamint Mountains. In the atmosphere of Death Valley in the month of August there is less than one-half of 1 per cent of moisture. Third, the country surrounding Death Valley, made up of volcanic ranges—black, red, green, yellow, and brown—wherein caustic mineralization has for countless centuries furnished the elements of sterility to every storm, torrent, and cloudburst that has, during these ages, washed down their sides, thus precipitating in the deep valley below the deposits of borax we now find there.

Death Valley Desert is thus surrounded by Ralston Desert on the north, Panamint Desert on the west, Mojave Desert on the south, and the Amargosa Desert on the east; and its depression being lower than any of the above, need we wonder that it should be a center of misery, when the hot rays of summer pour down upon it and the refracted heat strikes it from the Panamint and Funeral Mountain ranges. During the three summer months and first month of autumn the heat in Death Valley rises to 137 deg. to 139 deg., higher by far than anywhere else in the western world; not only does this heat exist there during the day but also during the night, for the mountains on either side and the hard surface of the middle valley, during the day heated like the walls of a furnace, do not have time to cool perceptibly until the sun again rises in a copper sky, and thus for weeks and months, unfavored by moisture, this great central isolated region toasts and burns, a land of silence and desolation.

It was during the winter of 1874 that I first beheld Death Valley. I had crossed Panamint Valley by way of Sherman Cañon and, after spending some days in the mining camp of Panamint, I, in company with two others, reached the summit of the Panamint Range, and from there looked down on Death Valley. The summit of Panamint Range rises 7,000 feet above sea level, and the view from the high altitude in a rarefied atmosphere is one never to be forgotten, although the region looked down upon is as desolate, woe-begone, and forbidding as would be an equal area of the moon. On the west lies Panamint Valley; to the eastward, Death Valley; to the north, the mountains around Darwin and Wild Rose Cañon, and to the south and east the forbidding and ten thousand times cursed devils of the Mojave and Amargosa, and rising up in beauty, though desolate, the Calico Range of hills that shows a richer coloring than did Joseph's coat of old.

Death Valley, as seen from the summit of the Panamint Range, presents in the month of November a long gray waste desert, in which there are narrow bands of white made by thin deposits of borax; and to the south end of the desert, one can see a thin line like a blade of steel, which is the faint outline of the Amargosa River, as it dies away upon entering Death Valley sink. This stream, which constitutes the Amargosa River, flows in from the south, then turns east and west, and flows around to the north. It is a sluggish, dead stream, that takes its rise from a number of springs in Nye County, Nevada. On its course it furnishes water for a few ranches and farms in the Amargosa Valley, and flows onward through a bitter alkaline country until, when it reaches the point where nature seems to have intended that it should supply a vast reservoir, it has no water to give. Evaporation and absorption have taken it all.

The land thus looked down upon was surely the center of a system of lakes. This was at a time when doubtless the Sierra Nevada Range had not yet arisen, when the winds from the west and south brought frequent and copious rains, when the precipitation was similar to what it was when Lake Bonneville, in Utah, was in its glory. On the sides of the Panamint Range one can yet see the old lake lines, and the same are evident in the mountains surrounding Panamint Valley, and also on the Calico Mountain Marsh of the Mojave Desert.

That is now all changed, and, as described above, we have the most uncompromising desert region in North America, or perhaps in the world, where once the billows of a stormy lake dashed against the cliffs of the Panamint and Funeral mountains.

It was as the sun was rising that we began our descent from Panamint Range to take our way across Death Valley. Our route was by way of Furnace Creek. We were on our way to Pioche, Nev., and our guide was an old mountaineer named Thomas Gillis, better known as "Tex." Our route lay across Death Valley, crossing Furnace Creek, and onward to the head of the Amargosa River. The descent from the summit of the Panamint Range is an easy one for pack animals, although the mountains rise steep and bald.

As one examines the formation of the Panamint he discovers them to be, toward their summit, of carboniferous limestone formation, rifted and worn, with a very slight growth of piñon pine, mahogany, and juniper, near the crests; and as one descends the vegetation becomes more scant. In the gorges and narrow cañons, one sees numerous vines and creepers, on which grow wild gourds about the size of oranges, which they much resemble; these grow down to the edge of the desert; and in their interior we find a bitter pulp which has a rather disagreeable odor. These are similar to the desert apples found in Syria, of which we read in Scripture—the bitter, disappointing fruit that grows near the site of ancient Sodom. Growing there, also, are the most distorted forms of the cacti—mean, thorny, stunted groups of these forbidding plants, and also, an inferior growth of greasewood or palaverde. The mountain talus lies in rolls and drifts until it reaches the edge of the valley, where we arrived at the forbidding gray flat, level as a billiard table, save where here and there an incrustation of soda in some form permitted the foot of man or beast to break through its thin crust. Upon reaching the level of Death Valley, what to us was most striking on that occasion was the tremendous height which the Panamint Range, which we had just descended, seemed to present. I distinctly remember that as I looked back upon them, and then upon the bleak, gray, desert valley before us, with the Funeral Range of mountains in the distance to the eastward, I recalled at once to mind that celebrated Valley of Diamonds into which Sindbad the Sailor descended for crystallized wealth, as described in the Arabian Nights Entertainments.

Our route lay directly across the sterile desert, and before us ran wagon tracks that were made the year before by miners and adventurers who came to the silver mines of Panamint from Pioche, Belmont, and Eureka, Nev. Old Tex, our guide, said that previous to the late Panamint excitement, one could see on that desert waste the tracks of the wagons owned by the early emigrants, of whom a number perished for want of water in the years 1849-50. When about 7 miles out on the desert we came across the bones of three oxen, cracked, worn, and weather-beaten, and a little further, three spokes, yet near it, and a little further away, lay the tire of this wheel but little rusted, although it had lain there almost 25 years. Yet a little further on, we picked up near the road the sole of an old boot; it was curled and distorted into a queer shape; and the heel was sloping to the sole, and the wooden pegs had so shrunken in the leather of the soles that upon taking up the old relic, they fell out. Still farther on, we found a broken china tobacco pipe, a few porcelain buttons, and four flat old-fashioned brass coat buttons. As we found these relics of former travel over the dreary and forbidding waste, old Tex said that they were part of the remains of the party who in the year 1849 or 1850 started to cross this desert without a guide. They had separated from a larger party, who had taken a course south from Las Vegas, in what is known as the State of Nevada, and who, in going from the Vegas to the south of the next one, had taken an old established route across the desert; but our unfortunate few believed that they could take a more direct route across the desert and over the Panamint Range of mountains. In taking this new route, the emigrants found it easy for a time, but after passing Ash Meadows their troubles began. Their descent from the Funeral Range into Death Valley was difficult, compelling them to abandon much of their property, and when upon the unknown desert they were without water, night was upon them and the days that followed saw the destruction of most of their number; for, in taking their way across the desert, the party became crazed with thirst and wandered in various directions; becoming delirious, many of them stripped themselves of all clothing and, like wild beasts, began to burrow in the hard desert sands with their bare hands. Two men named Towne and Waite along with Mrs. Towne and nine other persons escaped by reaching the Panamint Mountains and finding a spring. The remaining eighteen persons, men, women, and children, who composed the party left their bones in the desert; and one of the surviving twelve persons, named Bennett, gave the name of Death Valley to the dreary sinks of the Amargosa, on which he had so suffered and his comrades had perished in the terrible old days of overland travel in '49. The above is a brief history of an event almost forgotten, but which gave a name that will last as long as the English language is spoken on the American continent.

It would seem that the man Bennett, one of those who escaped, was the prime spirit in advising the Death Valley route instead of the route farther east, and by way of the sinks of the Mojave; and, after the disaster to his party, he showed to his friends in upper California a specimen of native silver, which he claimed to have broken from a five-foot ledge or vein, and which was but a day's journey west of Death Valley. He claimed to have found this vein near a spring, at which he was slaking his awful thirst. He carried the specimen with him and later on converted part of it into a foresight for a rifle. An assayer of Butte County, Cal., examining the sight made from the mineral specimen and also a part of the specimen from which it was formed, found that it was native silver. The statement of Bennett, whether true or false, created an excitement at once in Butte County, Cal., and a party was formed to return to the desert to rediscover what has since been known to fame as the Gun Sight Lode; but that lode was never found, and to this day, the hope of discovering the Gun Sight Lode prompts many a poor prospector to vainly search for that celebrated bonanza. The expedition from Butte County, Cal., in search of the Gun Sight Lode occurred in the early sixties, and many years after I met a man in Prescott, Ariz., who was one of the party. He said that they had no difficulty in finding the camping grounds of the first party that had largely perished in crossing Death Valley. Mr. Bennett accompanied Dr. Darwin French and they found the very spring where Bennett claimed to have found the silver ledge, but there was no sign of such a vein. They went further and found where the emigrants had separated and saw the scattered remains of the train, and every sort of personal property, lying where it was thrown by the desperate pioneers of 1849, but no evidence of any silver vein; and, disgusted with the outlook, the disappointed seekers for the Gun Sight Lode returned to Northern California.

Returning to my own experience. On our journey across Death Valley, we inferred that the articles we found were left there by the first train of emigrants, and Tex said that about two miles south of the point where these were found two skeletons had been found the year before, one of them that of a woman. The party who thus scattered and perished were peculiarly unfortunate, as the skeletons of four of them were found only about 300 yards from a small spring of excellent water near the foot of the Panamint Range.

Our own journey across this desert seemed slow; though it was in the month of November, the atmosphere was sultry, the air dry, and by noon the heat was oppressive. A smothering sensation would, at times, make itself felt. We were now midway in the desert, and our saddle and pack animals showing signs of extreme thirst, we gave each of them a gallon of water, which we had taken with us in kegs on the pack animals before starting across this barren waste. We had taken for each man two one-gallon canteens from Panamint and three gallons for each horse. Strange as it may seem, we had consumed the entire measure allowed for each man before we reached Furnace Creek, and our horses were mad with thirst when we reached the camp ground that evening. In the winter season there is really little danger in crossing Death Valley if precaution is taken to attempt the journey when there is no sand storm blowing and to have along with the party a good supply of water.

The desert is perfectly level, but not everywhere smooth, as in places there are weary areas, where salt soda and borax crystals extend over the surface to the depth of several inches, but the wealth of this desert is wholly mineral in its nature. Nothing pertaining to the vegetable kingdom is found on its central area and the approaches to it on either side show but the most woe-begone types of cactus, greasewood, and arrowweed. As evening fell upon us and we reached Furnace Creek we beheld a dozen small crows acting as scavengers around the camping place near the warm waters of the stream. Although the spot was one where very little greets the eye of the traveler, I do not remember a day of my life, the close of which was more welcome than that on which I crossed Death Valley, nor a spot I ever saw more welcome than Furnace Creek. This stream is small and takes its rise in the Funeral Range. Its waters are fairly good, and the place around the camp, when we visited it, showed the ruins of an old furnace and one or two ruined dwellings. Traditions differ as to the origin of these ruins. Some of those whom I asked for information relative to them, claimed that they were erected by the Mormons in the year 1857, for the purpose of smelting lead ore to make bullets for the Mormon militia, who were about to go out against Albert Sidney Johnston's army, then about to enter Utah. Others at San Bernardino, Cal., claim that these old structures were prepared by Spaniards some 75 years ago, who used them to smelt silver-lead ores. This last story seems the most probable. As we stayed two days, camping at Furnace Creek, I made a close study of the country adjacent, rode some distance up and down the edge of the desert, and examined minutely the old ruins at Furnace Creek Camp.

The old furnace, if furnace it once was, showed little slag to indicate that any considerable amount of ore had ever been worked there. I found no ores nor limestone, nor iron ore that might have been used as fluxes. In vain I searched for some specimens of iron or steel tools, implements, or materials that would give a key to whether the place was constructed by Americans or Mexicans, but if there had been such left in bygone days, they had been long since gathered in by the Mexicans. However, on the second day of our sojourn at the camp, I found about a quarter of a mile from the old ruins, an old gunlock. It was that to an old flintlock musket; it was rusted and broken; and on the plate was deeply engraved "*Tezanes* 1783," from which I inferred that it was the lock of an old Spanish musket, but this might have been obtained by some Indian or white traveler at one of the old California missions and carried to this place. During our first day's rest at Furnace Creek, we had an opportunity of seeing a sand storm playing its pranks on Death Valley in the forenoon. We could see sand augers rising here and there out in the distant wastes. These rise like slender stems, reaching up into the burning atmosphere for thousands of feet and terminating in a bushy cloud. They travel hither and thither for miles and gradually fade from sight as the current of air that formed them changes its course and manner.

Here mirage performs its wildest capers, raising up spectral cities, groves, fields, and woods-margined rivers. While crossing the desert, toward evening, we could imagine that we saw beautiful groves ahead of us, and the old ruin grew until it seemed to be a structure hundreds of feet in height. The arrowweeds by the stream were magnified into stately palms, and the half dozen crows that walked about the old camp ground seemed as men on horseback.

Of life we found in the region a few very poor jack-

* Mines and Minerals.

rabbits, saw one or two mangy coyotes, the half-dozen aforesaid crows, a few buzzards, horned toads, one venomous red-eyed rattlesnake, a few mice, and one or two specimens of mountain rats of peculiar species. To the northwest, in the Panamint Range of mountains, there are still found a few of the big-horned mountain sheep.

Midwinter brings snow to the summit of the Panamint and Funeral ranges of mountains, and it is said that the thermometer in these heights at times falls to 30 degrees below zero, but not so in the deep sinks of Death Valley. There the days of midwinter are pleasant when at their coldest. The sand storms of winter sweep up and down that dreary waste, and the moisture that falls on the mountains above rarely precipitates any moisture upon the parched desert below.

The mineral wealth of the region in and around Death Valley is great. In the Panamint Range are many mines of antimonial silver ore, where, although the bodies of ore are not extensive, they are many and very rich. Copper, gold, and iron also are found in this same range, as also travertine, onyx, and marble; and in the Funeral Range, gold, silver, lead, copper, and antimony have been found in paying quantities, while the thick strata or measures of the east and southeast hills show almost inexhaustible quantities of colemanite, which is a borate of lime named for a Mr. W. T. Coleman, who was one of the first to discover this deposit and find out its richness in borax. I firmly believe that there exists in the wilds of the Death Valley region what men have so long known as the Gun Sight Lode. Mr. Bennett seems to have been too earnest in his search not to have been honest in his statement of having found such a vein. I believe, however, that he made a mistake about the exact locality in which he picked the specimen. Very rich gold quartz and much wealth has been taken from mines along the route traveled by that old emigrant party, but no such vein of native silver as Mr. Bennett describes has yet been found there, although the region is an ideal one for the existence of such a vein. To those who would visit Death Valley, I would say, go there if you will, but do not go earlier than October 15, nor later than April 15. Do not attempt to cross it while a sand storm is blowing, and do not start across without a gallon of water for each person in the party, and, if possible, three gallons for each horse. At present one can go from Dagget on the Atlantic & Pacific Railroad, but the route is little better than from Panamint to Furnace Creek and up through Nevada via Pioche, Nev. The region is sterile, but interesting to the student, and may be made profitable to the miner, inasmuch as the natural wealth of the entire region round about lies wholly in its minerals. It is not a grazing country. It is not a land that can ever become dotted with farms, or gardens, or orchards. Ages on ages will roll away, and new generations of men will follow each other after the riches of this world, but ten thousand years will not bring green fields nor smiling cottages to Death Valley or its sister deserts.

And yet, within the area of this desolate part of California, man's persevering labor will not for ten thousand years exhaust the mineral wealth that lies hidden within the dark chambers of the Panamint, Funeral, and Calico ranges of mountains, nor from under the surface of Death Valley. Gold, silver, lead, antimony, copper, iron, manganese, bismuth, marble, jasper, borax, soda, and niter will continue to be found here centuries after we, who now walk the earth, shall have returned to dust.

As to society of the human type abounding in the Death Valley it is confined to a few miners in the Funeral, Calico, and Panamint mountains who mine for gold, silver, lead, and copper; a lesser few that mine borax in the flats; and a few roving bands of Piute Indians who hunt the jack-rabbit and gather the pinenut in the high parts of the surrounding ranges. There are a few squaw men leading a sort of isolated life on mountain ranges, owning a few cattle and horses, and, in a small way, interested in mining. At Ash Meadows, to the eastward of Death Valley, we found living on a cattle ranch a Mr. Winters, his wife, and one or two hired men, who ruled the destinies of about 300 square miles. His wife was Spanish, he himself an American, his hired men, one an Irishman and the other a German. His ranch was the stopping place, yea! the haven of rest for every wanderer who in those days passed through that country. His wife strove to make everyone happy by making them welcome.

My acquaintance with the sparse population of that desolate part of California rather impressed me in their favor. Others have painted them as renegades, vagabonds, squaw men, and lizard-devouring Piute Indians, little above the brute. I cannot say other than that I found the few human beings of that lone part of our great country endowed with a broad humanity, kind, generous, and hospitable.

AN ENGLISH REPORT OF THE WEST INDIAN ERUPTIONS.

IT will be remembered that the Royal Society of England recently sent out an expedition to study the volcanic eruptions of the West Indies. According to the New York Sun, the report submitted by the expedition contains a very interesting statement of the work the torrential rains are doing in removing the deep layers of volcanic dust under which a large part of the surface of northern St. Vincent was buried by the ebullitions from the Soufrière volcano.

South of the volcano were a number of deep valleys extending nearly or quite across the island from east to west and clothed before the eruption with the most luxuriant tropical vegetation. The great black clouds discharged from Soufrière and heavily laden with incandescent dust fill these valleys with outpourings to a depth in some places as great as 200 feet.

Very little of the mass was deposited on the ridges between the valleys, for the force with which it was hurled was too great to permit it to lodge on the ridges. The hollows received most of the volcanic sand, which lay in rolling masses like drifted snow. This was the first geographical alteration which the outburst made in the appearance of that region.

Six weeks later another change had taken place and the appearance of the valleys was again strangely altered. The wet season had set in and as much as five inches of rain were recorded in a single day.

The torrents pouring down the great hill slopes were playing havoc with the loose material that had filled the valleys. The surface was everywhere scarred with rain furrows that joined together, in a sort of feather pattern, into larger streams which cut still deeper channels into the soft material. These channels also united, forming rivers to take the place of the old ones which had been buried out of sight. In some places they re-excavated the old channels, while in others they cut new and quite independent ones.

The amount of denudation accomplished in a few weeks would seem incredible to one accustomed to the leisurely rate of change in temperate climates. The Wallibu excavated a new bed in the still hot volcanic sand nearly 80 feet deep and left in places as many as five or six terraces to mark the successive stages of its excavation.

The torrents of water after digging a channel would undermine the steep banks on either side, starting landslides of hot dust which fell into the river, causing explosions of steam which threw showers of hot mud to a height of perhaps 150 feet, while great clouds of steam rose to a height of many hundred feet and were carried away to the sea by the trade winds.

There was another interesting phenomenon. Sometimes the fallen dust dammed the streams, and when the water at last overcame the obstruction it descended no longer as water, but as a gush of boiling hot mud which made the river beds impassable, and built up alluvial layers of mud spreading out like fans (alluvial fans) at the mouths of the rivers.

The explorers brought home many photographs showing the progress of these interesting phenomena. One of them depicts the rolling and rounded character of the surface of the deposits and the many furrows and gullies that had already been cut by the rain. Another taken in the Wallibu Valley shows the terraces of hot sand marking the level to which the valley had been filled by the eruptions and some of the successive stages of its re-excavation. Weeks after the eruptions the sand was still so hot that steam was produced wherever water came into contact with it.

Other pictures show the alluvial fans formed at the mouths of the rivers, and new beaches along the sea that had been formed in about a month of the material washed from the cliffs or carried down by the rains.

Thus the forces of nature are rapidly changing the new topography that was introduced by the eruptions. A vast amount of the volcanic débris is being washed down to the sea.

If the two West Indies volcanoes which have done so much damage return soon to their former quiescent state it will not be many years before all the land surface they so completely desolated will be covered again with tropical verdure; and the present desert-like aspect will be wholly replaced by myriad forms of vegetable life that will hide the scars and blisters on the surface which were produced during a few terrible hours.

THE GUM-BICHROMATE PHOTO-PRINTING PROCESS.

GUM-BICHROMATE is not a universal printing method. It is not suited for all subjects or for all negatives, but where there is simplicity and breadth in sizes of 8½ x 6½ and upward, direct or enlarged prints by it have a charm altogether their own, and afford an opportunity for individuality greater than any other method.

While almost any kind of paper will do, there are certain qualities that the beginner at least should endeavor to secure. It should be tough enough to stand the necessary handling, which is considerably more than in either the printing-out or developing methods. It must not be so hard or smooth as to make coating difficult, nor so porous as to absorb or let the coating sink too much in; but a few trials will show just what surface is best. Till that experience is acquired I may say that most of Whatman's or Michallet's drawing papers, to be had at any artist's materials store, will be found all that can be desired; or, failing these, the sizing of almost any good paper will make it almost as suitable.

For sizing a weak solution of gelatine is generally employed, but arrowroot is better; half an ounce to a pint of water. It should be beaten into a cream with a little of the water, the rest added, and brought to the boil. When cold it may be applied with a sponge or tuft of cotton, going several times, first in one direction and then in the other, and it saves a little future trouble to pencil mark the non-sized side.

The quality of the gum is of less importance than is generally supposed, so long as it is the genuine gum arabic, and in round, clean "tears." To make the solution I select an eight-ounce wide-mouth bottle, of the tall rather than the squat variety, and place in it six ounces of water. Two ounces of the gum is then tied loosely in a piece of thin muslin and suspended in the bottle so as to be about two-thirds covered by the water. Solution begins at once, as may be seen by the heavier liquid descending, and if kept at the ordinary temperature of the room may not be complete for 24 or even 48 hours; but the keeping qualities of the solution will be greater than if the time had been shortened by heat. When all that will has been dissolved, there will still be a quantity of gelatinous matter in the muslin, but on no account must it be squeezed out, as the semi-soluble matter thus added to the solution would be injurious. With the addition of a few drops of carbolic acid and a good cork the gum solution will keep for months.

Neither do I find the selection of the pigments such a serious matter as some of the writers would lead us to believe. Tube water colors are convenient and save the trouble of grinding, but I think the cheap colors in powder take a better grip and give richer images. The best prints I ever made were with mixtures of common lamp-black, red ocher, sienna, umber, and Vandyke brown, the only objection to their employment being the necessity of rather carefully grinding. This may be done with a stiffish spatula and a sheet of finely-ground glass, the powder mixed with a little gum solution and rubbed with the spatula till smooth, but I prefer a glass paper weight in the shape of cone with a base of about one and a half inches in diameter, bought in a stationer's for 25 cents.

The sensitizer is a 10 per cent solution of potassium bichromate, and whatever be the pigment or whatever the method of preparing the coating, it may be useful to keep in mind that the right strength or proportion, or at least a strength of coating that answers very well, is equal parts of that and the gum solution.

In preparing the coating I measure the gum solution in a cup from a toy tea-set that holds exactly one ounce, it being easier to get it all out of this than out of a conical graduate. From 20 to 30 grains of the color or mixture of colors in powder is placed on the slab—the ground surface of an "opal" answers well—and enough of the gum added to moisten it, and work the paper weight "muller," aided by the spatula, as I had seen the painter's apprentice do in the long, long ago, as long as any grittiness remains, or till it is perfectly smooth, adding more and more gum till it is like a thick cream. It is then transferred to a squat teacup and one ounce of the bichromate solution gradually added, working it in with one of the brushes to perfect homogeneity. Of course, it will be understood that this mixture should be used all at once, or rather only as much as is to be used at once should be made, as notwithstanding what has been said to the contrary, it will not keep, and I may say here that after each operation, both or all of the brushes should be thoroughly cleaned before putting them away.

Not the least important are the brushes; one about two inches wide and soft for laying on the coating, the other, unless for small work, twice that breadth and of what is known as "badger" or an imitation thereof, for softening. I say an imitation, if it can be got, as badger is expensive to a degree that only one with a pretty full purse will care to invest in it. But its purpose is to soften or smooth the coating, and as upon the perfection of that operation much of the success depends, the cost should not be allowed to stand in the way.

The paper I am using at present comes in sheets of about 17 x 22 inches, and I cut that in two, coating pieces of about 17 x 11. The sheet is fastened to a drawing board by drawing pins, one at each corner. The coating brush—mine of camel's hair, but I have been told that "hog's" is better—is filled with the creamy mixture, which has been transferred to a saucer as more convenient, and with even strokes, first one way and then the other, drawn all over the paper. It is easier to do than to describe, but I may say that all three joints, wrist, elbow, and shoulder, take part, and unless the surface of the paper is too smooth, there is really no difficulty to speak of.

By the time the whole surface has been covered the paper will have expanded to an extent that makes it necessary to remove three of the pins and tighten it, and then comes the most important and the only really difficult part of the work, the softening. The softener is held exactly as I hold the pen in writing, and the motion confined altogether to the wrist, bringing only the points of the hair in contact with the coating, more like stippling than painting.

If much of the coating has been laid on, and too much is less of an evil than too little, the softener will soon have taken up so much as to require washing. This I do at the tap, drying on a soft cloth, and continue the operation, the strokes or touches gradually becoming lighter and lighter, till the surface is as smooth and free from markings as if it had been floated.

Just how thick the coating should be is most easily learned by experience, but as, unlike ordinary carbon, development begins from the exposed surface, it must be as deep; that is, as dark on the paper as the deepest shadow on the intended print, *and it should not be deeper.*

While it is true that the bichromate colloid is not sensitive while wet, I always do the coating in subdued light, indeed, generally at night, and hang the sheets to dry, in the dark room.

Exposure should be made with some form of actinometer. I employ the Wynne's print meter, all my negatives as soon as made being marked with the time taken to give a print on solio, not the over-printing required for a print that is to be toned and fixed, but to the extent only that a finished print should be, and that is pretty near right for either carbon or bichromate.

Development may be conducted in various ways, and is modified according to the extent of the exposure. I began by floating the exposed sheet on water at the ordinary temperature from the tap, and prefer an exposure that will admit of complete, or nearly complete, development in that position in from five to ten minutes; although I do not generally allow it to go so far. By turning up a corner from time to time I see how it goes, and at the suitable stage depending on what I really want to do to modify the otherwise plain outcome of the negative, gently withdraw it from the water and pin it up to dry.

The modifying operation might be done at once, where the exposure has been long enough to admit of it, but generally, and especially when it has been such as to, in my opinion, admit of the best result, the image is too soft, too easily washed off to make it safe. But after having been dried and again moistened by immersion in water, the desired modification may be made with safety.

The moistened print is now placed on a sheet of glass, the lower end of which rests on the bottom of the developing tray, and supported by the left hand at a suitable angle; or, better still, in some other way so as to leave both hands free. In this position, and with water at various temperatures, camel's-hair brushes of various sizes, and a rubber syringe, I can do practically anything I like.

Gum-bichromate, wrought in this way, is just the opposite of the method of the painter. He makes a picture by laying on material, and his work is fine art because of that. Photography, in the gum bichromate, lays it on, and the photographer, equally by the work of his hand, makes a picture by taking off all that he does not want; and as both are equally the

work of the brain-guided hand, their claim to be or not to be works of art depends on the quality of the brains and not on the methods.—The American Amateur Photographer.

THE USE OF ALCOHOL AS FUEL AND ILLUMINANT.

At the exhibition of the Automobile Club of France, which recently took place in Paris, one entire section was devoted to appliances for lighting and heating by means of alcohol. We reproduce from La Nature a number of cuts illustrative of some of the apparatus of chief interest which were on view.

The lamp, 2, in Fig. 1, is fitted with a Landi burner.

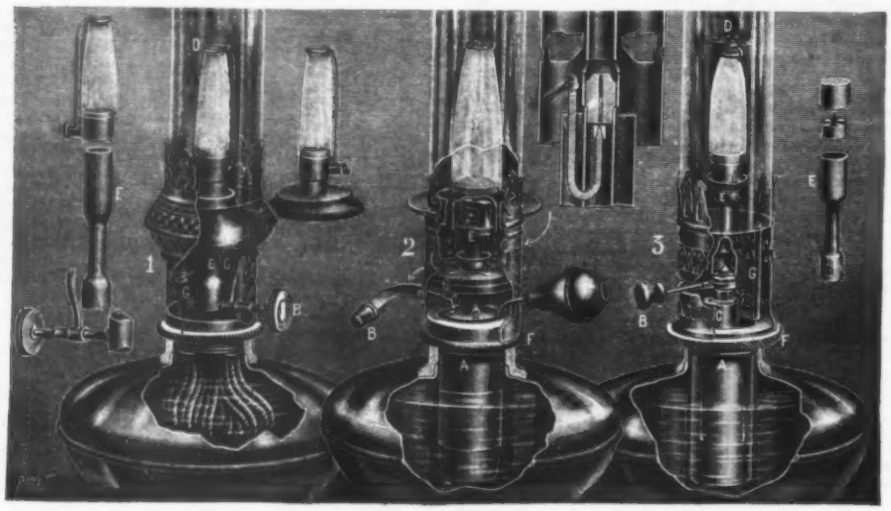


Fig. 1.—1. DELAMOTTE BURNER. 2. LANDI BURNER. 3. DENAYROUSE.

This latter consists of a regenerative jet, *E*, with a double envelope of wick, *A*, immersed in the alcohol. This arrangement is calculated to avoid excessive heating of the fuel in the reservoir. The tube along which the alcohol rises is open below in order to prevent the liquid from being carried into the flame. The lamp is lit by aid of a fixed asbestos ring, *G*, into which a little alcohol is squirted by means of a small rubber bulb. The lamp is extinguished by means of the lever, *B*.

The Denayrouse burner (Fig. 1, No. 3) for incandescent light is fitted with a somewhat elaborate copper support for the mantle. In order to keep the liquid in the reservoir cool, the wick is passed through a German-silver tube, *C*, this material being a bad conductor of heat. The tube, *C*, is furthermore surrounded by an air space. The lamp is regulated by means of the thumb-screw, *B*.

In the Delamotte burner (Fig. 1, No. 1) the alcohol is vaporized by means of auxiliary flames at the base of the Bunsen. The tube and chimney of the Bunsen can be taken to pieces by hand, so that the lamp is readily cleaned. This burner has to be lighted with a torch.

Next to the lamps at the exhibition was a space for heating apparatus. Among these the Decamp stove deserves special notice. It is represented in Fig. 2, No. 2. The alcohol from the reservoir, *R*, is sucked up by the wicks in the tube, *A A*, to the box, *E*, where it is vaporized. It issues through an injector provided with a needle-valve, *D*, and mixes with air in a central chamber, at the top of which it escapes through a ring burner. This latter is surmounted by a metallic cup, *C*, which is continually heated by the flame and which communicates its heat to the lower tank, *E*. To light the heater, an alcohol torch is introduced through an opening, *F*, thus heating the cup, *C*, and starting the heater.

Fig. 2, No. 3, shows the "Préféré" heater and some of its internal arrangements. Behind the grate is a reservoir for the alcohol, communicating by the tap, *C*, with the tube, *G*, whose horizontal portion forms the vaporizer. This tube, *G*, is prolonged upward so as to encircle the upper part of the grate, and just before reaching its highest point is expanded for a short distance into a little chamber. This arrangement efficiently prevents any liquid from being carried into the flame. The alcohol vapor mixes with air in *E*, and the tube, *F*, acts as a reservoir for the gaseous mixture which feeds the burner proper, *B*. From this the burning vapor rises in big flames beating against the asbestos walls of the fireplace, which are raised to incandescence and radiate heat out into the room, thus increasing the efficiency of the heater. The products of combustion are carried away by a flue opening at the back of the heater.

An interesting form of heater for a bath was exhibited by the firms Fouilloud and Grosjean. This is shown in Fig. 2, No. 1. The water tank, *B*, is tubular and of the geyser type. *A* is the inlet for the water, and *C* the exit tube to the bath. The entire alcohol heating apparatus is firmly fixed to the lower door of the heater. For lighting or trimming the burners the door must be opened, as shown in the cut. A simple push button device provides that while the door is open no flow of water takes place through the geyser. The jets, *F*, nine in number, are of the Fouilloud type, without wicks, burning alcohol under pressure. They are set around a reservoir, *R*, in which the alcohol is placed under pressure by means of a small hand pump, *E*. The alcohol is distributed to the nine burners from a central chamber, *G;* each jet has its own regenerator, Bunsen burner, and cup for lighting it. By means of a stopcock the nine flames can be regulated and extinguished.

There were also exhibited some explosive motors; of these one presents some features of particular interest. It is a small fire engine driven by an alcohol motor, designed by M. Chauveau (Fig. 3).

The power for working the double piston pump, *P*, is transmitted directly through a system of cog wheels from the 3½ horse power motor, *M*. The pump can project 66 gallons per minute to a distance of some 100 feet. The motor also serves to propel the pump. It is suggested that this little engine can also be used to pump up the water supply in a residence. The total weight of the apparatus is only 550 pounds, so that it can be moved about quite easily.

RESULTS OF TESTS OF ALCOHOL MOTORS IN GERMANY.*

The special situation of Germany is favorable for the employment of alcohol as an agent of motive power. The production of alcohol is very great, on account of the duty of 6 marks per 100 kilog. on petroleum, and the distance of most of the factories from the railways increases the cost of coal and petroleum. Of seven millions of hectoliters of 100 deg. alcohol produced in Germany, 2,600,000, or 85 per cent, proceeds from the agricultural distilleries, and 91 per cent of the total is made from potatoes.

M. Oelkers has published in a recent pamphlet a full account of the experiments made in Germany on alcohol as a source of power. A summary will be of interest.

The first test was made by the Grob firm, of Leipsic. In the experiment the motor consumed per horse power 839 grammes of alcohol against 436 grammes of petroleum. This at first does not appear encouraging, but a prize of 10,000 marks was decided on by the government, and a special institute was organized.

Prof. Havy contrived an alcohol sprayer, which lowered the consumption of 90 deg. alcohol to 450 grammes. The Korting firm soon afterward succeeded, with an atomizer of their invention, in reducing the consumption of 93 deg. alcohol to 390 grammes per horse power.

The necessity of lowering the price of lighting alcohol had caused an improvement in the legal conditions of denaturation. The original denaturant consisted of 4 parts of methylic alcohol and one part of pyridine, and cost from 75 to 100 marks per hectoliter. The alcohol thus denatured cost 18.43 marks, instead of 16.65 marks before denaturation.

Great efforts were made to secure the denaturation of benzol, a sub-product in the manufacture of coke. A liter of 90 deg. alcohol denatured with 5 per cent of benzol cost only 16.54 pfennig, instead of 16.65 before denaturation. This was a decided gain. A denaturation so advantageous was authorized in 1899 in certain localities. It embraced, for 100 liters of pure alcohol, 2 liters of benzol and 1¼ liters of the mixture of methylic alcohol and pyridine. Finally, the reduction on industrial alcohol was carried from 3.50 to 4.50 marks. On account of these different benefits and of the interest which the associated distillers took in the industrial utilization of alcohol, the price was brought down to 25 frs. per 100 liters of 90 deg. alcohol, carriage free throughout the German empire.

by benzol, a sub-product in the manufacture of coke.

It is possible to run explosion motors on 85 to 90 deg. alcohol. It is advantageous that alcohol should be denatured with benzol, the addition of 15 to 20 per cent of benzol being the most favorable proportion; if more benzol is added the consumption is raised per horse power. The percentage of benzol is based on the respective prices of benzol and alcohol. The combustion of a mixture of benzol and alcohol is a perfect one, so that the gases produced are deprived of odor; and the danger of accident from fire is slight, as compared with the danger of benzine or gasoline.

The consumption of alcohol for good motors reaches 350 to 420 grammes on the average per horse power.

The alcohol motors develop 25 per cent more power than benzine motors of the same dimensions. Rust is usually produced in the cylinders of the motors when the spraying is not sufficient; this is completely avoided when the alcohol is atomized, after being sufficiently heated. The danger of rust requires special attention in the choice of materials for electric ignition. The piston and cylinder of the alcohol motor, worked for about 2½ years at the experimental distillery, are in perfect condition.

The practical or industrial yield of alcohol motors is very high; it is calculated as follows, on a consumption of 400 grammes of alcohol denatured with benzol:

One kilogramme of alcohol of 90 deg. in volume develops 3,650 calories for a density of 0.834.

One kilogramme of benzol, C_6H_6, having a specific weight of 0.886, develops 10,330 calories.

For a test, we have mixed 80 liters of alcohol = 66.7 kilogrammes, or 376,368 calories, and 20 liters benzol = 17.7 kilogrammes, or 182,841 calories. Therefore we have a mixture of 100 liters = 84.4 kilogrammes, or 559,809 calories.

The calorific power of 90 deg. alcohol, denatured with 2 per cent of benzol, is therefore 6,633 calories per kilogramme.

The practical yield of motors consuming 400 grammes of this mixture is calculated as follows, allowing 427 as the mechanical equivalent of the heat:

The complete combustion of 1 kilogramme of alcohol, giving 6,633 calories, would yield:

$$\frac{6{,}663 \times 427}{3600 \times 75} = 10.49 \text{ horse power.}$$

If the consumption is 400 grammes per horse power, one kilogramme would yield 2.5 horse power. The practical yield is therefore 2.5 ÷ 10.49, or 23.8 per cent, while the practical yield of the best steam engines does not exceed 13 per cent.

Not including the Diesel petroleum motor, whose practical yield would reach 29.4 per cent, we find the yield of the principal motive agents as follows: benzine, 14 to 18 per cent; petroleum, 13 per cent; steam,

* From the French of M. Leplae, in the Bulletin de l'Association des Anciens Eleves de l'Ecole Supérieur de Brasserie de Louvain.

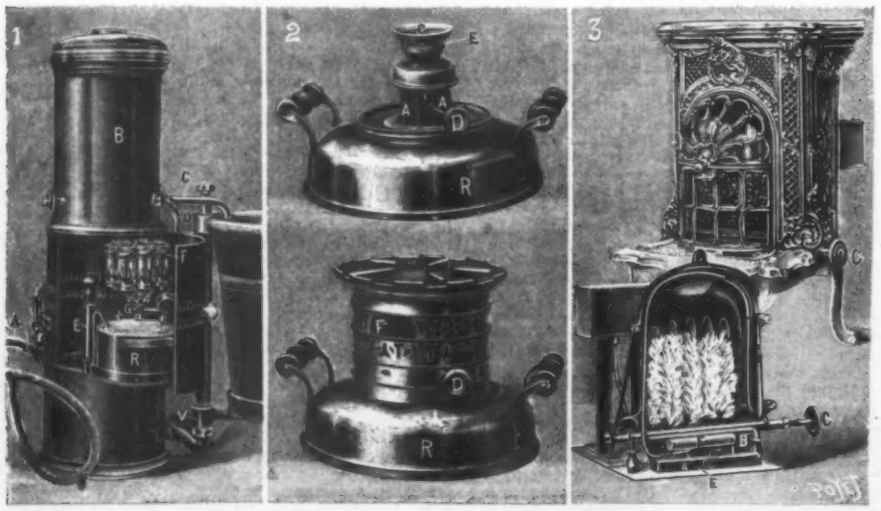


Fig. 2.—1. BATH HEATER, FOUILLOUD-GROSJEAN. 2. DECAMP HEATER. 3. PREFERE FIREPLACE.

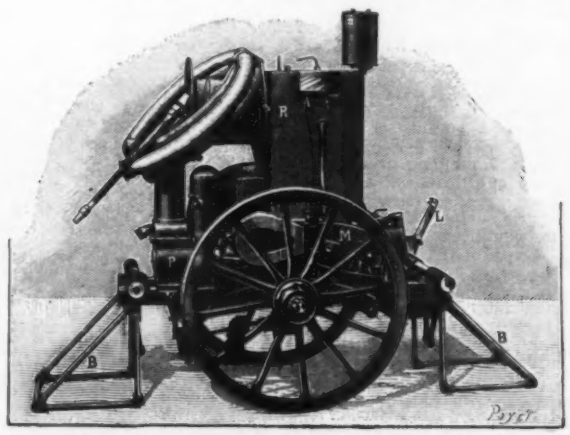


Fig. 3.—CHAUVEAU FIRE ENGINE.

13 per cent; gas, 18 to 31 per cent; alcohol, 23.8 per cent; alcohol is therefore quite superior to benzine, petroleum and steam.

Causes of the High Thermic Yield in the Alcohol Motor.—The calorific power of alcohol is scarcely 6-10 of that of petroleum or benzine, and its much higher yield results from a greater perfection of the cycle. The principal improvements are:

1. Stronger compression of the mixture, giving 6 or 7 atmospheres for alcohol, instead of 5 for petroleum; this is rendered possible by the higher fusing point of alcohol, and also because it contains a certain quantity of water. The Diesel motor, with its elevated yield, compresses the explosive mixture to from 35 to 45 atmospheres.

2. A greater part of the exhaust heat, in the heating of the sprayer, can be utilized, because the spontaneous ignition of the mixture is not to be feared.

3. The combustion of petroleum and gasoline is not complete, and there is consequently waste.

4. Alcohol being already an oxygenated compound, its complete combustion can be obtained without introducing an excess of air.

5. Special chemical decompositions giving rise to unascertained explosive gases, are perhaps produced at the time of ignition. The following experiment may be cited in support of this hypothesis: in a combustion of alcohol of 85.9 per cent in weight in the calorimetric bomb, the pressure in the bomb was kept up for 10 seconds at 60 atmospheres, and during this period, the variations of pressure were noticed, reaching five atmospheres for one-half to one second, probably proceeding from dissociation.

The cylinders are not incrusted and the motor does not disengage any odor.

The Alcohol Motor with Reference to Economy.—The comparative cost price in Germany is, for motors of 10 horse power, as follows:

	Av. consumption.	Cost of unit.	Cost of horse power (Centimes).
Alcohol.....	400 gr. = 470 c.c.	24.6 centimes (liter)	11.6
Benzine.....	350 gr.	47.5 " (kil.)	16.6
Petroleum..	400 gr.	31.2 " (kil.)	12.5

In Germany the alcohol motor is a little dearer than that of petroleum, and more economical than that of benzine. Taking in account the absence of odor, the greater neatness, and the certainty of the rate of the alcohol motor, preference may be given to it, whenever the denaturation with benzol is utilized; that is, throughout the German empire.

The German alcohol industry is free from duty by means of a denaturation, costing 3.10 francs per hectoliter of pure alcohol. The denaturation with 5 per cent benzol costs 1 franc per hectoliter. Under these conditions, the cost price of pure alcohol of 100 deg., and that of denatured alcohol, are as follows:

	Francs.
100 liters of alcohol of 100 deg.....	47.50
Deducting impost	24.387
100 liters alcohol free from duty....	23.113
1 liter of 90 deg. costs.....	0.20813

Denaturation with the general denaturant:

	Francs.
100 liters of alcohol free from duty..	23.113
Denaturant, 2.5 liters at 1.25 francs.	3.125
1 liter of 90 deg. alcohol costs.....	0.23037

Denaturation with benzol:

	Francs.
100 liters of alcohol free from duty.	23.113
5 liters benzol at 0.20 franc.....	1.000
1 liter of 90 deg. alcohol costs.....	0.20675

For all uses in which the power of the motor does not exceed 30 to 40 horse power, the alcohol locomobile is the most advantageous. Counting the depreciation at 12 per cent per year, with 300 days of work per year, the total cost per effective horse power is 19.86 centimes for steam; 17.48 for alcohol; 22.44 for benzine; 18.31 for petroleum.

There are now considerably more than a hundred alcohol motors in use in Germany, against seventy-six on January 12, 1900.

THE RED DEER IN NEW ZEALAND.

AT a recent meeting of the Zoological Society, according to Knowledge, an extract was read from a letter from Mr. D. Russell, Hon. Sec. to the Otago Acclimatization Society, giving an account of the successful naturalization of the red deer in New Zealand. Two stags and six hinds had been turned out in 1868, and their offspring now numbered between 4,000 and 5,000 individuals. The carcasses of some of these deer weighed from 500 to 600 pounds.

OIL-COOLED GASOLINE ENGINES.

THE freezing of the water, heretofore thought necessary for the cooling of the cylinder of gasoline engines, has placed decided limitations to their extended use, especially for agricultural purposes. The gasoline engine has become well recognized as the most economical and convenient source of power for all small industries, and radical improvement in this power is of most far-reaching importance.

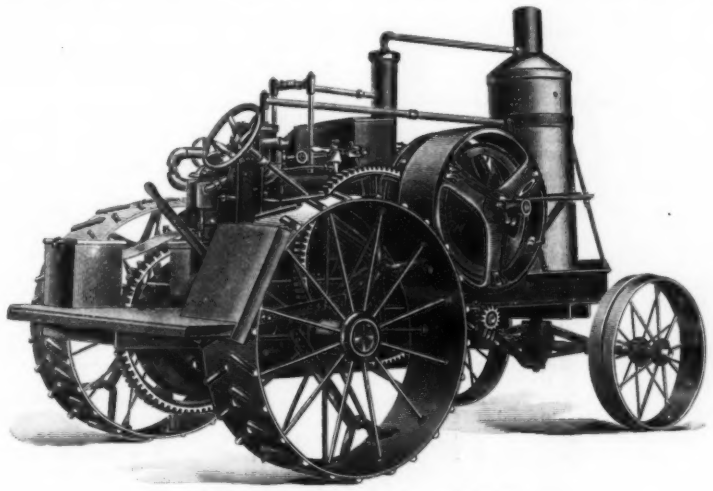
A decided improvement recently brought about in this line is the development of an oil-cooling system for the cylinder. It is here shown applied to a gasoline traction engine, and consists of a tank connected at the top and bottom with the cylinder jacket of the engine. A small centrifugal pump causes a rapid circulation of the oil from the jackets to the tank and back to the cylinder jackets. The tank, connections, and jackets are sealed air-tight, so that no waste of the oil can take place, and the original supply will last as long as the engine.

Passing upward through the tank are a large number of tubes like boiler tubes, open at the bottom and opening at the top into a conical space below a short stack which surmounts the tank. The exhaust from the engine is carried into this conical space and turned upward into the stack, and thus a rapid flow of air induced upward through the tubes. The cylinders give up their heat to the oil surrounding them, the oil passes into the cooler, and in turn gives up heat to the air passing upward through the tubes, and returns to the cylinder at a low temperature to receive a new charge of heat.

This form of cooler has been successfully applied to engines of over 40 horse power. It cannot freeze, requires no attention, and works well under any climatic conditions. For small engines this system of cooling may be applied without the oil pump, natural circulation being sufficient. An ordinary radiator, such as is used for hot-water heating, connected in place of the usual water tank, filled with oil and sealed, will work within certain limitations of size.

The gasoline traction engine here shown also marks a successful innovation of the gasoline engine in a field heretofore occupied by the steam traction engine for road hauling, plowing, and driving various portable machinery.

The origination, development, and manufacture of a full line of oil-cooled, stationary, portable, and traction gasoline engines has for several years been the work of the Hart-Parr Company, formerly of Madison, Wis., recently removed and now located in a modern new plant at Charles City, Iowa.



GASOLINE TRACTION ENGINE.

THE BABYLONIAN AND ASSYRIAN LEGENDS OF THE CREATION.*

IT is now a little more than thirty years since the learned world was startled by the announcement that Assyriologists had discovered a remarkable version of the history of the Creation, which closely resembled the narrative of the first chapter of the Book of Genesis, and appeared to be based upon the archtype from which one of the earliest editors or writers of the Pentateuch drew many of his statements. The interest shown in the discovery of the Babylonian and Assyrian account of the Creation was widespread, and though it did not equal that displayed by the learned world in the story of the Deluge as unfolded from the cuneiform records by the late Mr. George Smith, it was sufficiently important to move Assyriologists to further exertions and to provide them with a public which has been ever ready to welcome the results of their labors with toleration and praise. The credit of the discovery of the cuneiform Creation records in the British Museum belongs, undoubtedly, to Sir Henry Rawlinson, and it must ever be a subject for lament that his official occupations prevented him from laying his work before the world in a suitable manner many years before his assistant, Mr. George Smith, was able to do so. In the preface to the work before us, Mr. L. W. King, of the British Museum, has continued, and, we are glad to add, completed, as far as is possible at present, the work which was begun by Sir Henry Rawlinson, and he presents to us the whole of the available material in a form handy to use and easy to study.

The first volume of the "Seven Tablets of Creation" contains a useful preface, a good introduction, and transliterations into English letters of all the cuneiform texts, with clear translations arranged opposite them; five appendices, an index and a glossary complete the volume. In the second half of the work, we have the original cuneiform texts, and as they are written in a good, bold hand, the curious reader will find no difficulty in verifying any of Mr. King's statements. After sketching briefly the services which have been rendered by earlier editors of the Creation legends, Mr. King passes on to describe the new material which he has found as the result of several examinations of the collections of clay tablets from Kuyunjik now in the British Museum. In the thirteenth part of "Cuneiform Texts," published by the Trustees of the British Museum in 1901, Mr. King gave copies of a number of documents relating to the Creation, among them being several which, though used by previous workers, had not been published, and one which had been consulted by Mr. Smith in 1876, but had been apparently lost sight of. Great credit is due to Mr. King for identifying this last mentioned important fragment, for, so far as we have been able to discover, it was not recognized by Dr. Bezold, who, in his "Catalogue of the Konyunjik Collection" (p. 998, K. 9267), describes it merely as "part of a mythological legend." While, however, Mr. King was searching for fragments of other Babylonian legends, he discovered so many new portions of the Creation legends and duplicates that he decided to write a monograph on the subject, and as the result of his labors we are now able to form a connected idea of the whole of the Babylonian story of the Creation. Formerly, only twenty-one tablets and fragments inscribed with portions of the legend were known, but now no less than forty-nine separate tablets and fragments have been identified as containing portions of the cuneiform texts of the Creation series. In fact, Mr. King has identified twenty-eight new portions and duplicates of Creation texts, and the details of the great story can now be followed consecutively, a thing which up to the present, has been impossible.

We now know that the great Babylonian poem of Creation was divided into seven sections, or tablets, and that the whole work was known by the title "Enuma Elish," which also forms the opening words of the text, and that it contained nine hundred and ninety-four lines; those who are interested in ancient theories of numbers will note that 994 is a multiple of 7. Each of the seven sections on tablets contained, on an average, one hundred and forty lines, and it is clear that each tablet was intended to describe the events of one "day" of creation. It is difficult not to think that such artificial divisions of the legend indicate that we are dealing with a comparatively late recension of it, and this may well be the case when we remember that the oldest copies of it which we possess date from the reign of Ashur-bani-pal (B. C. 668-626); no one who takes the trouble to read the seven tablets and who is familiar with ancient cosmogonies and theogonies will have the slightest doubt that the original form of the Babylonian and Assyrian history of Creation is many thousands of years old. Whether it originated with the Akkadians or some other non-Semitic people cannot be said definitely at present, but it is very probable that the Semitic Babylonians were only the borrowers and not the inventors of this remarkable work.

We may now note the main heads of the legend. At the beginning of all things, Apsu and Tiamat were water deities and typified chaos; to these were born Lahmu and Lahamu, and later appeared Anshar and Kishar, and still later Anu and other gods came into being. One of the newly-found fragments of the first tablet mentions the birth of Nudimmud (Ea), and although Damascius states that Bel, the creator of the world, was the son of Ea and Damkina (Ἀδῦ, Δαυκίνη), it is clear from the fragment that Marduk, who is made to take the leading part in the later tablets of Creation, was supposed to be in existence, like Mummu and Gaga. In the earlier episodes of the Creation story, it is Ea and not Marduk who is the hero, and we learn for the first time, from the new material, that it was Apsu, a god of chaos, and not Tiamat who rebelled against the gods. Apsu disliked the new order of things and the creation of the universe for the simple reason that the beings who formed members of the new world disturbed his peace and rest; as soon as he had made up his mind as to what was likely to happen, he called Mummu his minister (the *Μωυμῆς* of Damascius), and the two went to Tiamat and took counsel with her, and complained that "he could get rest neither by day nor by night." The putting of the house of the world into order by the gods destroyed his rest and peace of mind. Of the conflict which took place between Ea and Apsu and his ally Mummu we know little, but that the great god did not succeed in inflicting a decisive defeat on Apsu and his allies is clear from the fact that, later, Anshar found it necessary to exhort Marduk to do battle with Tiamat. Of the defeat and death of Tiamat we need say little, for the story of how the god of light slew her and split her body into halves is familiar to all. The actual account of the creation of the world by Marduk begins toward the end of the fourth tablet, where it is said that one-half of the body of Tiamat formed a covering for heaven, and that Marduk, having formed E-shara, made the great trinity of Anu, Bel, and Ea to dwell therein.

In the fifth tablet, we hear of the fixing of the constellations of the Zodiac, the founding of the year, etc., and it seems as if this section contained an account of the creation of vegetation. The sixth tablet, as we know from one of the new fragments, told the story of the creation of man, and it seems as if Marduk made man with the view both of punishing the gods and of providing a creature who should at all times worship him. Marduk, or Bel, instructed Ea to cut off his (i. e., Marduk's) head, and the man was formed out of the blood which flowed from the god's body. Marduk is made to tell Ea that he intends to create man from his own blood and from the "bone" which he will create; it is important to note that the Assyrian word for "bone" is *issimtu*, and that it is the exact equivalent of the Hebrew *'esem*, "bone," which occurs in Genesis ii. 23, in connection with the account of the creation of woman.

The creation of man was the final act of creation,

* "The Seven Tablets of Creation." By L. W. King. Vol. i. English translations. Pp. cxxiv. +274. Vol. ii. Pp. xiii and 84 plates. (London: Luzac, 1902.)

and when this was accomplished, the gods assembled in their council chamber in Upshukkinaku, with Marduk at their head, and they sang to him a hymn of praise, the text of which forms the seventh section of the Creation story and contains fifty addresses to the god. How Marduk managed to survive his decapitation is not told us, and we can only surmise that he met the gods in their council chamber in some sort of spiritual body. The space at our disposal will not allow us to call attention to many very interesting details of the legend, especially in the parallels which may be drawn between parts of it and the Book of Genesis; these prove beyond all reasonable doubt that the Jews borrowed large portions of their religious literature from their kinsmen the Babylonians, and that the seven days of Creation were imagined long before the days of the patriarch Abraham. The student of comparative folklore will find much to interest him in Mr. King's latest work, and will perhaps trace the mingling of legends illustrated in it with somewhat mixed feelings. Mr. King's texts are carefully edited and well copied, and his translations, which we have examined in several passages, are faithful and not unduly literal, and his work is a credit to English Assyriology.—Nature.

ARTIFICIAL PRODUCTION OF RUBIES BY FUSION.

IN spite of his persevering researches M. A. Gaudin has not succeeded in obtaining melted aluminium in the transparent state.

The cause of this failure is to be found in the employment of too elevated a temperature, for if the temperature is raised considerably beyond the fusing point, the oxide crystallizes, producing an opaque product.

For this reason it is impossible to refine a mass of aluminium to a considerable depth with the aid of the oxyhydrogen blow-pipe, because only by overheating the outer layer is it possible to liquefy the deeper portions. Then, finally, it is found that the transparent aluminium obtained is furrowed with a multitude of cracks, due to the contact of the melted coating and the subjacent aluminium not yet melted. These indications lead to the conclusion that the problem cannot be solved except by observing the following conditions:

1. The melted product must be always kept in the same region of the flame.

2. The mass must grow in size by layers superposed from the bottom to the top, in order that a series of thin layers may be refined.

3. Fusion must be effected, when the contact of the melted product with the support is reduced to an extremely limited surface.

The first of these conditions is realized by employing a vertical oxyhydrogen blowpipe, by means of which the flame is thrown in the direction of a support, moving from the top downward, and which may be lowered by turning a close-threaded screw, thus making it possible to remove from the blowpipe the melted product as it rises, and to take it into the zone suitable for fusion, when the latter will have been driven to a distance from the end of the blowpipe by the progressive increase given to the intensity of the flame.

I secured the formation of the melted mass, consisting of thin layers superposed from the bottom upward, in conformity with the second condition mentioned above, by the aid of a method which may be called a process of *semage* (sowing, distribution) and which consists in submitting chromated aluminium powder, or pulverized natural ruby, to the current of oxygen which feeds the blowpipe. This matter placed in a chamber above the central tube of the blowpipe, is thrown into the oxygen current by blows from a small hammer acting mechanically. The aluminium or ruby grains* thus distributed in every part of the flame, will be fused as soon as they reach the sufficiently hot zone coincident from the beginning of the work with the support designed to receive the melted mass.

This support, formed of a small cylinder of aluminium, agglomerated at a red heat with a few hundredths of potassium carbonate, is placed exactly in the axis of the blowpipe, and its surface is brought, by suitably adjusting the flame, to a temperature slightly below that of the fusion of aluminium, in order to agglomerate only the grains which fall on this surface and form a cone, whose summit enters gradually into the part of the flame sufficiently hot to effect its fusion. Henceforth, all the grains which fall on the melted top become liquefied, and the filament obtained (which thus reduces the contact of the matter with the support to a very small surface) increases gradually in diameter, so that it is raised and enters a hotter and larger zone of the flame, being transformed at its summit into a sphere, of which the diameter must be increased as much as possible. This is effected by admitting oxygen progressively by means of a stopcock with close-threaded screw.

Lighting gas having been admitted in great excess from the beginning of fusion, the increase of the flow of oxygen causes the displacement of the zone suitable for fusing, which recedes progressively from the end of the blowpipe; therefore, in lowering the support which carries the mass, the upper part of the melted sphere must be brought back into this zone; the characteristic boiling which takes place under the influence of a flame, too hot or too rich in oxygen, is an indication for always bringing back the product to the desired region.

In order to maintain the fixity of the flame and to regulate the radiation, the operation is conducted inside of a small cylindrical clay furnace having a sight-hole for following the phases of the fusion. By employing a blowpipe having an extremity of 12/10 of a millimeter (dimensions beyond which it becomes difficult to form at the outset a sufficiently fine melted point) it is possible to obtain in two hours a perfectly refined ovoid mass of uniform color, weighing from 2.5 to 3 gr.; that is, about 12 or 15 carats. Such a mass has a diameter of from 5 to 6 millimeters, when it is spherical.

* Aluminium precipitated with 2.5 per cent of chromium oxide and calcined is the best form in which it can be employed.

As soon as these dimensions have been reached, toward the end of the work, the inlet of the two gases is at once cut off, in order to secure a thorough hardening of the product. Under this condition only, and provided that the mass has been well centered and uniformly heated, it splits exactly in two halves in a vertical plane. Each one of these semi-spheres, cut by means of processes employed by lapidaries, furnishes a ruby, similar to the one I present to the Academy.

These rubies possess a magnificent red fluorescence and are of a density of 4.01. All the lapidaries to whom they have been exhibited find that they possess the same hardness as the natural ruby and can take its beautiful polish.

When their production has been perfectly successful, it appears impossible to distinguish them from the most beautiful natural rubies, but frequently, especially in the case of large stones, they present two defects which indicate their artificial origin, and constitute the real difficulty encountered in correctly conducting a fusion. Imperfect refining at some points has the effect of producing groups of small bubbles, which may be distinguished with a strong magnifying glass. Their formation is due, either to an exaggerated *semage*, or to the employment of a flame containing too much oxygen.

The second defect, still more characteristic, consists in the presence of ribboned zones, due to the decoloration of certain portions by the volatilization of chromium, when the *semage* has been too much relaxed. These defects, which otherwise do not diminish the beauty of the stones, when they are mounted, will lessen, and may even disappear, as soon as it has become possible by well-conducted experiments to master the difficulty of the *semage*.—From the French of M. A. Verneuil. Paper presented to the Académie des Sciences. Specially translated for SCIENTIFIC AMERICAN SUPPLEMENT.

COMBINATIONS OF ALUMINA WITH CHROMIUM SESQUIOXIDE; CONSTITUTION OF THE RUBY.*

M. LECOCQ DE BOISBAUDRAN has determined the circumstances in which alumina combines with oxide of chrome, and has concluded from his experiments that in the ruby the compound is found in the state of sesquioxide. I have discovered a method of separating the chromium oxide not combined in these experiments.

1. The oxide, whether anhydrous and heated for an hour and a half at the white red, or crystallized, disappeared rapidly and totally in potassium chlorate, leaving the alumina.

I heated:

	1.	2.	3.	4.	5.	6.
Chromated alumina...	0.7875	1.011	1.0195	1.094	0.8855	1.0245
Chromium oxide.....	0.045	0.00275	0.1045	0.137	0.20	0.3295

I recovered:

Chromated alumina...	0.79025	1.03525	0.13	1.0915	0.884	1.0230
Loss of alumina ...	0.34	0.55	0.63	0.33	0.17	0.14

This is therefore a method which allows of determining the proportion of chromium oxide combined with alumina when the two oxides are heated together.

I operated first with pure alumina calcined in the Perret furnace, and chromium oxide. The mixture of the two oxides was calcined for half an hour in the Leclercq and Forguignon furnace, at the temperature of the white red. The mass resulting from the action was treated with potassium chlorate, and the residue recovered with water. These are the results of three experiments. Percentage of chromium oxide, 15.27, 15.22, 16.04.

Notwithstanding the coincidence of these numbers, I did not decide on a definite combination (calculated for the two 15.78), for the rosy violet color was mixed with green, and was similar to that of mixtures richer in oxide of chrome, which I have recovered by employing gelatinous oxides.

2. In the second place, I prepared various ammoniacal mixtures of chrome alum and of alumina alum, the latter contaminated with potassium sulphate, and precipitated the boiling solution with ammonium carbonate, washed the precipitate, and operated on the mixture of oxides obtained as before.

The alum contained 10.95 per cent of alumina (average of 10.94 and 10.96); the chrome alum, 16.05 per cent of oxide (average of 16.01 and 16.10).

The mixture contained from 10.35 to 37.87 of alumina, which was recovered within about one or two hundredths.

The poorest products obtained were of rosy tint, with more or less violet; in later experiments, a green tint, more or less intense, appeared.

3. Lastly, I heated mixtures prepared in the same way, in which the chromium oxide was in great excess in reference to alumina. The final product was green; treated with ammonia, it communicated a yellow tint, and the liquor retained alumina in solution.

The results of the second series of experiments showed that the quantity of chromium oxide which may be combined with alumina is greater than might be expected from the experiments of M. de Boisbaudran, but they confirm his conclusion relative to the state of oxide in the ruby. They impart great weight to those conclusions by giving the exact proportion combined.

In fact, the consequences which might be drawn with regard to the color are illusory. Thus, the mixtures at 15 per cent obtained with calcined alumina are poorer in chromium oxide than the mixtures, still rosy, obtained with gelatinous alumina. Yet they have a tint resembling that of the latter mixtures, in which the proportion of 28 per cent was reached.

* From the French of M. Dubois. Communication to the Académie des Sciences.

METHOD OF CULTURE OF SEA ISLAND COTTON.*

ON account of the prominence of this cotton to cotton spinners all over the world, a short description of its culture will be of interest. Drainage has of necessity always been practised to some extent on the sea islands. The remarkably high beds on which the cotton is planted there—18 inches to 2 feet high—subserve this purpose. The best planters have long had open drains in their fields. These were generally made by running two furrows with a plow and afterward hauling the loose dirt out with a hoe, thus leaving an open ditch, if it may be so termed, a foot or more in depth. In recent years the farmers have made deeper ditches and placed plank drains in them. Seeing the great benefit resulting from this, they subsequently replaced the plank with regular drainage tile. The outlets open on the sea at the low-water mark, and the pressure of the water on the pipes preserves a constant outflow, even at high tide. In this manner land only 1 or 2 feet above high water is susceptible of thorough drainage to the depth of 4 and even 5 feet.

Fallowing is practised to the extent that land planted in cotton one year is pastured the next by cattle and sheep.

Planting may begin any time after March 20th, although April 1st to 10th is generally preferred.

Cotton planters are not generally used. Three laborers do this work; the one ahead chops a hole with a hoe, on the top of the bed, at intervals of 12 to 18 inches; another drops 8 or 10 seeds in each hole, and a third follows and covers carefully with the hoe.

The seed makes its appearance above ground in 8 or 12 days after it is planted, and the stand is perfected from the second week in April to the first week in May. Hoeing begins about the first of May. The plows then break out the middles (the spaces between the new beds where the old beds stood). The hoe hands follow and pull up the loose dirt left by the plows to the foot of the cotton. This is called "hauling," and by it the new bed is completed, the cotton is kept from "flagging" (falling down), and the grass is kept under.

At the second hoeing some stalks are thinned from the bunch in which the seed breaks the ground, and at each succeeding hoeing and hauling other stalks are removed, until in July only one stalk of each bunch is left. There are four hoeings and four haulings, one or more furrows, with a sweep being run through the middles previous to each hauling. By the last of July the culture is completed, except to run a furrow between the rows in August to destroy the grass and keep the cotton growing.

The first blossoms appear about the middle of June, when the cotton is 15 inches high, and the bolls open in August, when the plants have attained a growth of 4 to 5 feet. Cotton picking commences from the last week in August to the first week in September.

When the cotton has been picked, weighed and housed, it is next spread out in the sun on what is called an "arbor." This is a platform 25 feet or more square, made usually of inch boards. Here the sun and air dry the cotton, preventing it from heating, which it is liable to do when stored in bulk, and, it is also thought, causes the lint to absorb some of the oil in the seed, which adds to the silky luster of the fiber. After being thus dried, it may be either stored or passed at once to the whipper, a machine that knocks the dust and sand out and leaves whiter and more open. Formerly it was all assorted. A hand was given 150 pounds of seed cotton as a day's task, which he thoroughly overhauled, picking out all specks, stained cotton, fragments of leaf, etc. At present, however, this is usually done by two hands, who examine the cotton as it passes to the gin, and two others behind the gin, who pick out cracked seed, motes, etc., as the lint issues from the gin. The roller gin in some form has always been and still is used for detaching the lint from this black seed cotton.

The first successful crop of Sea Island cotton was grown by William Elliott, on Hilton Head near Beaufort, S. C., in 1790.

The highest prices Sea Island cotton brought was when in 1825 a Mr. Kinsey Burden, of South Carolina, sold 60 bales at $1.10 per pound, and also sold his crop for another year for $1.25 per pound, when the average price of uplands was 9¼ cents. In 1828 the same gentleman sold two bales at $2 a pound, which price will remain the highest Sea Island cotton was ever sold for. About 1899 the cultivation of Sea Island cotton was taken up among the small farmers of the pine levels at a considerable distance inland from the sea. So successful has this adventure proved that in 1894 the Sea Island crop of Georgia rose, while that of Florida fell, and South Carolina, where this culture has originated and flourished longest, fell way back entirely. It had seemed for many years that islands on the South Carolina coast possessed a natural monopoly for the production of the finest staple. At that time the culture was conducted under the superintendence of men of high intelligence, and the selection of the seed and the cultivation and preparation of the crop for the market was attended to with great skill and the most scrupulous care. At present it is chiefly in the hands of small farmers of the colored race, whose intelligence, skill, and care are wholly occupied in securing a bare subsistence for themselves. It is doubtful if there is any local monopoly of the production of long staple cotton. It has been grown successfully in the upcountry, more than 100 miles from the coast, and all the seed from which the finest strains of Sea Island cotton have been derived came from seed planted in the interior of South Carolina, for several years during the civil war.

The culture of Sea Island cotton in the interior of Georgia is not so elaborate as the method described as pursued on the coast. Seed is brought every year from the coast in quantities to plant patches sufficient to furnish seed for the whole crop the ensuing year. The seed of the second season is thought to do better, but after that the staple deteriorates and seed is used which has been planted away from the coast only one year.

The general culture resembles that of upland cotton, and is usually performed entirely by the farmer and his family.

* Textile Record.

TRADE NOTES AND RECIPES.

Weatherproof, Quick Drying Paint.—In 50 liters of spirit of 96 per cent dissolve 16 kilos of shellac, orange, finely powdered, 3 kilos of silver lake, finely powdered, and 0.6 kilo of gamboge finely powdered. This paint may be employed without admixture of any siccative, and is excellently adapted for painting objects which are exposed to the inclemencies of the weather, as it is perfectly weatherproof.—Maler Zeitung.

Preparation of Prussian Blue by the Use of Cyanogenated Deposit.—The cyanogenated deposit serving as a base for Prussian blue is used as a material for the preparation of different cyanogenated products of commerce. It is essentially composed of an insoluble double salt of ammonium ferrocyanide, with a little ferric sulphide, a solution of ammonium sulphate, ammonium carbonate, and ammonium sulphide.

To draw from these the Prussian blue, so esteemed as a coloring matter, the present process is as follows:

The double salt is isolated, and by means of alkalies or alkaline earths it is converted into soluble ferrocyanide, which, under the action of ferric oxide, added with or without ammonia, yields the Prussian blue. If, instead of a salt of ferric oxide, a ferrous oxide salt is employed, Prussian white is at first produced, and afterward converted by oxidation into Prussian blue. The new preparation is based on the following observation, to wit, that the Prussian white, converted by oxidation to Prussian blue, already exists in the deposit, and that it is sufficient for isolating it, to remove from the deposit the ammoniacal compounds, with the ferric sulphide which may be found in them.

To eliminate these bodies from the cyanogenated deposit, the latter is submitted to heat for quite a long time; the volatile ammoniacal compounds are thus disengaged. Then the deposit is composed only of Prussian white and a solution of ammoniacal sulphate, which are separated by pressure, after having rendered soluble, by the addition of sulphuric acid, the ferric sulphide which may be present.

This process by heat, which is inconvenient in certain circumstances, may be avoided by adding concentrated sulphuric acid to the cyanogenated deposit until neutralization. In the treatment the volatile ammoniacal compounds are converted into ammonium sulphate, with disengagement of hydrogen sulphide and carbonic acid, so that, after isolation of the insoluble cyanogenated compounds, known under the name of Prussian white, there remains a concentrated solution of ammonium sulphate.

The isolated Prussian white is then oxidized by known methods and converted into the Prussian blue of commerce.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT, from the German in the Farben Zeitung.

Protection for Cement Work.—According to W. Cremer (Journal für Gasbeleuchtung und Wasserversorgung) a coating of soluble glass will impart to cement surfaces exposed to ammonia, not only a protective covering, but also increased solidness.

A communication to the Deutsche Bauhütte states that cemented surfaces can be protected from the action of the weather by repeated coats of a green vitriol solution consisting of 1 part of green vitriol and 3 parts of water. Two coatings of 5 per cent soap water are said to suffice to render the cement waterproof; after drying and being rubbed with a cloth or brush, this coating will become glossy like oil paint. This application is especially recommended for sick rooms, since the walls can be readily cleaned by washing with soapy water. The coating is rendered more and more waterproof thereby. The green vitriol solution is likewise commendable for application on old and new plastering, since it produces thereon washable and waterproof coatings. From old plastering the loose particles have first to be removed by washing.

Stain to Produce the Weathered Effect on Oak.—Water color stains do not penetrate deep enough into wood to make the effect strong enough, hence solutions of other material than color are being employed for the purpose. Aqua ammonia alone, applied with a rag or brush repeatedly, will darken the color of oak to a weathered effect, but it is not very desirable, because of its tendency to raise the grain. Bichromate of potash, dissolved in cold water, applied in a like manner, until the desired depth is obtained, will serve the purpose. These washes or solutions, however, do not give the dark, almost black, effect that is at the present time expected for weathered oak, and in order to produce this, 4 ounces of logwood chips and 3 ounces of green copperas should be boiled together in 2 quarts of water for 40 minutes and the solution applied hot. When this has dried it should be gone over with a wash made from 4 ounces steel filings and one pint of strong vinegar. The steel filings are previously put into the vinegar and allowed to stand for several days. This will penetrate into the wood deeply, and the stain will be permanent. Picture frame manufacturers use a quick-drying stain, made from anilin blacks.—Painters' Magazine.

Carmine Lake for Wall Paper and Colored Papers.—Ammonia soda (98 per cent) 57.5 kilos, spirits (96 per cent) 40 kilos, corallin (dark) 10 kilos, corallin (pale) 5 kilos, spirit of sal-ammoniac (16 degrees Bé.) 8 kilos, sodium phosphate 30 kilos, stannic chloride 5 kilos, barium chloride 75 kilos.

First dissolve the corallin in the spirit, and filter the solution carefully into eight bottles, each containing 1 part of the above quantity of spirit of sal-ammoniac, that is 1 kilo each, and let stand.

The soda should meanwhile be dissolved in hot water and the solution run into the stirring vat, in which there is cold water to the height of 45 centimeters. Now add the sodium phosphate, which has been dissolved in a copper vessel, then the corallin solution, and next the stannic chloride diluted with three pailfuls of cold water. Lastly the barium chloride solution is added.

The day previous barium chloride is dissolved in a cask in as little boiling water as possible, and the receptacle is filled entirely with cold water.

On the day following allow the same to run in slowly during a period of three-fourths hour, stir till evening, allow to settle for two days, draw off, and filter.—Oesterreichische Farben- und Lack-Zeitung.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Paints and Varnishes in Eastern Turkey.*—The following data apply more particularly to the twin cities of Harput and Mezreh. The conditions are practically identical in the other commercial centers of this part of the empire.

Varnish.—The merchants import annually about $200 worth of varnish, of a very inferior quality, for the use of local cabinetmakers and other artisans. It comes from France, in bottles containing one-fourth of a pound, retailing at 8 cents apiece. Local cabinetmakers, especially those who have had experience in America, complain bitterly of the poor grade, the difficulty in applying it, and the slowness in drying. A good quality of American varnish, once introduced here, would supply a long-felt need.

Paints.—Some ochers are produced in this country, which is exceedingly rich in minerals. Most of the pigments, however, are procured from Germany, through Constantinople houses. They come in the dry form, packed in tins of 1 kilogramme (2.2 pounds). These tins retail at $2.50 to $3.25. The trade amounts to about $700 per annum. Blue, green, yellow, purple, and white are chiefly in demand. Soot is employed for black.

The linseed oil employed is produced in the country itself, and is of inferior grade and poorly boiled. No driers are employed. Turpentine and benzine are exceedingly expensive, and even petroleum is costly in the interior. In consequence of this state of things, woodwork is rarely painted, except in the buildings occupied by the American Mission and Euphrates College.

The climate here is exceptionally dry, but much more paint and varnish could be advantageously used were good materials available at reasonable prices, accompanied by full and plain instructions for their preparation and employment.

On account of heavy freight charges, it would be eminently desirable to have very careful instructions on the proper preparation of the native linseed oil, as well as the most economical method of using the available driers.

Mr. S. G. Vartabedian, who has worked in the United States and is doing much to introduce American wares here, would be glad to take an agency for American colors and varnishes and push their sale actively. He can be addressed in the care of this consulate.

I shall take pleasure in furthering any effort to establish a market for these articles here and in the adjoining region.—Thomas H. Norton, Consul at Harput.

Opening for Chemicals in Budapest.—Consul F. D. Chester writes from Budapest, March 5, 1903:

My attention has been called by a Rotterdam firm† to the fact that Germany exports a quantity of magnesium carbonate and oxide to Hungary, and that there are American factories of these articles. The firms of Ferdinand Nernda and Frederick Kochmeister's Successor, in this city, wholesale chemical dealers, and many Budapest druggists (whose names can be had by applying to this consulate), could probably be induced to import the American article direct, though not through Holland or Germany. Hungarian statistics of the import of these articles are indefinite, but there is no doubt that this is a good market for chemical materials and products.

Commercial Museum at Malta.—A museum was opened here about sixteen years ago, under the auspices of the Austro-Hungarian consulate. In this museum were displayed samples of goods from the above country, and several of the lines have since become standard here. Especially was this so in the matter of bent-wood furniture; to-day there is probably no house in these islands not provided with Austrian bent-wood furniture. Within the last three years American manufactured goods have made their appearance here, but the demand has not been as large as if our merchants had been more enterprising. During this period there has been a falling off in Austrian manufactures, and it is probably to check this that the Austro-Hungarian consul-general at this port is about to open another museum. He has given, for a period of twelve months, a house—of which he is the owner—to be devoted wholly to the display of samples of goods from his country. The industrial classes of Austria-Hungary will be invited to forward such specialties for exhibition as may interest the people here. Goods are to be brought and returned free of freight charges by the Adria Steamship Company, of which line the consul-general is also local agent. The customs authorities will permit goods intended for the exhibition to be admitted free of duties, under proper restrictions. The plan is to display samples and provide information as to addresses of manufacturers, trade prices, and names of local agents, should there be any, in Malta. There is no reason why American manufacturers should not follow this plan. I have no house at my disposal to devote to the purpose, like my wealthy colleague, but premises could be secured in a much better location than that to be occupied by the Austro-Hungarian exhibition, and the rental would be reasonable. I believe that if a few of our manufacturers would join in contributing to a fund to cover expenses—which would not be heavy—and send samples of goods that Malta could use, there would be good returns. The New York and Mediterranean Steamship Company now runs vessels direct from New York to Malta, and satisfactory arrangements as to freight rates could doubtless be made.

Among the classes of goods that might be sent, I may mention shelf hardware, carpenters' tools, food stuffs, dry goods, soaps, men's furnishings, lamp goods, stationery, pianos, musical instruments for band or orchestra, and house fittings. It would be useless to send most lines of machinery; there is, however, a slight demand for woodworking machinery to be run by foot power, and I believe that bookbinding machines would attract attention. Lately large numbers of iron bedsteads from Birmingham, England, have found ready sale.

During the past four years the imports of our goods have risen in value from the end of a list of twenty exporting countries to fifth position, and, with a little enterprise, there seems to be no reason why we cannot mount still higher. Banking facilities are ample. The people here have an excellent opinion of American goods, and the market is prepared for them. To be sure, Malta is very small and its demands are relatively limited, but the business of most houses is made up of small things as well as of large ones, and Malta can at least prove a factor in the trade.—John H. Grout, Consul at Valletta.

Trade Notes from Costa Rica.—The chief exports of Costa Rica last year were:

	U. S. gold.
Coffee	$3,179,818.47
Bananas	1,833,344.55
Cedar	117,007.80
Mahogany, rose, and dye woods	53,189.62
Hides and skins	106,464.20
Rubber	60,286.20
Cacao	24,051.20
Bullion	
Gold	127,503.98
Gold and silver	9,718.57
Gold dust	5,992.00
Coined gold and silver	3,911.00
Live stock	4,340.80
Miscellaneous	43,312.06
Parcels post	20,565.30
Baggage	492.44
Returned goods	24,428.32
Total	$5,614,426.51

Compared with 1901, the total exportation shows an increase of a few thousand dollars. Coffee has a gain of over $350,000; bananas, $300,000; and cacao, $15,000. Mahogany and other woods show a decrease of $75,000, and rubber a decrease of $16,000. If the item of gold and silver coin is left out of the exports for the two years, the shipments of 1902 exceed those of 1901 by about $600,000. On the same basis of comparison, excluding the coined money from both imports and exports, the exports of 1901 exceeded the imports by over $900,000, while those of 1902 exceeded the imports by about $1,400,000.

Of exports there go to the United States less than 20 per cent of the coffee, all the bananas, more than three-fourths of the hides, more than two-thirds of the rubber, and all the bullion.

The banana industry shows a marked increase, the shipments being the largest in the history of the industry in Costa Rica.

The coffee was distributed as follows:

	Per cent.
To England	75
To the United States	15
To other countries	10

—John C. Caldwell, Consul at San José.

Concession for Quarrying Lithographic Stone in Mexico.—A concession has been granted by the Mexican government to Messrs. H. H. Moran and J. Emilio Meyer for the quarrying and preparation of lithographic stone. The following is an abstract:

"The concessionaires are to work a quarry of lithographic stone, on land belonging to the government, leasing the land or acquiring it by purchase. Six months after the date of concession, the company shall submit plans of the buildings, machinery, and materials, as well as plans of the territory to be worked. Construction is to commence within one year and to be completed within three years. The government will appoint an inspector and the company must pay into the treasury $3,000 yearly, for salary and inspection expenses, payments to cease when work-shops and machinery shall have been erected. The sum of $100,000 is to be invested in the enterprise. The company is to import apparatus, materials, tools, etc., free of duty. The plant is to be open to scholars of the national schools, and the company shall give the students such information as may enable them to pursue their studies intelligently. The capital, buildings, and other property of the company are to be exempt from federal taxation, except the stamp tax. The company is to be Mexican and subject to the jurisdiction of Mexico."—Wm. W. Canada, Consul at Veracruz.

German Request for Bones for Knife Handles.—Consul J. J. Langer writes from Solingen, March 10, 1903, that he has an inquiry from the firm of Kotthaus & Co., Solingen, for the names of concerns in the United States which deal in bones suitable for making handles for knives, etc.

Exposition at Sillein, Hungary.—Consul F. D. Chester sends the following from Budapest:

Plans are being made to hold an industrial exposition at the city of Zsolna (Sillein) in North Hungary, from August 15 to September 20 of this year. It will include Hungarian manufactures, farming machines and implements, motors, and general machinery. There will be a special section for homemade articles, women's handiwork, gardening, and apprentices' work. As the export of embroideries, etc., from Hungary to the United States in 1900 was over $5,000 in value, this exposition will interest some of our importers.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 1613. April 6.—*Bicycles in China—Moscow-Dalny Through Service—Coal and Petroleum in British Columbia—Canadian Railway to the Yukon—*International Exhibition at Liege—*Congress of Thalassotherapy in Biarritz.

No. 1614. April 7.—Trade of Spain in 1902—*Paints and Varnishes in Eastern Turkey—*Opening for Chemicals in Budapest—Australian Wool Shipments—Financial Measures Proposed in Haiti.

No. 1615. April 8.—Lignite, Peat and Coal Dust Fuel in Germany.

No. 1616. April 9.—New Tariff of Persia—*Concession for Quarrying Lithographic Stone in Mexico—Swedish Brake for Electric Motors—*german Request for Bones for Knife Handles.

No. 1617. April 10.—Coal, Steel and Iron Production of France in 1902—Trade in Norfolk Island—*Exposition at Sillein, Hungary.

No. 1618. April 11.—Transportation Problems and Progress in Germany—*Waterworks for Guayaquil.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

* Report made in reply to an inquiry from an Ohio firm, to which advance copy has been sent.

† New York agents, A. Van der Laan & Co., No. 18 Broadway.

SELECTED FORMULÆ.

Insect Powder.—

Pyrethrum	8 parts
Quassia	4 parts
Borax	6 parts
Turmeric	4 parts
Oil of cedar wood	1 part

Reduce the solids to a fine powder, mix and work up to a fine homogeneous powder in which extinguish the oil of cedar.—National Druggist.

Dressing for Patent Leather.—

Wax	22 parts
Olive oil	60 parts
Oil of turpentine	30 parts

Melt with gentle heat, the wax in the olive oil, and as soon as melted remove from the fire. When nearly cold stir in the turpentine.—Drug. Circular.

Ink Tablets.—

Galls	84 parts
Madder	6 parts

Percolate with hot water until exhausted and add to the solution

Ferrous sulphate	11 parts
Ferrous acetate	4 parts
Indigo carmine	1 part

Evaporate to dryness and make the residue into suitable tablets by the aid of gum arabic.—Drug. Circular.

A Hair Tonic with Peculiar Properties.—The following, according to a correspondent of the National Druggist, gives an elegant luster and keeps the head free from dandruff, but it separates and must be shaken before use.

Gum tragacanth	1 ounce
Salt	2 ounces
Coal oil	2 ounces
Aqua ammonia	1 ounce
Soft water	1 gallon

Waterproof Cement.—

Alcohol	1,000 parts
Sandarac	60 parts
Mastic	60 parts
Turpentine oil	60 parts

Dissolve the gums in the alcohol and add the oil and stir in. Now prepare a solution of equal parts of glue and isinglass, by soaking 125 parts of each in cold water until it becomes saturated, pouring and pressing off the residue, and melting in the water bath. This should produce a volume of glue nearly equal to that of the solution of gums. The latter should, in the meantime, have been cautiously raised to the boiling point in the water bath, and then mixed with the hot glue solution.

It is said that articles united with this substance will stand the action of cold water for an unlimited time, and it takes even hot water a long time to affect it.—Drug. Circular.

How to Keep Lamp Burners in Order.—In the combustion of coal oil a carbonaceous residue is left, which attaches itself very firmly to the metal along the edge of the burner next the flame. This is especially true of round burners, where the heat of the flame is more intense than in flat ones, and the deposit of carbon, where not frequently removed, soon gets sufficiently heavy to seriously interfere with the movement of the wick up or down. The deposit may be scraped off with a knife blade, but a much more satisfactory process of getting rid of it is as follows: Dissolve sodium carbonate, 1 part in 5 or 6 parts of water, and in this boil the burner for five minutes or so. When taken out the burner will look like a new one, and acts like one, provided that the apparatus for raising and lowering the wick has not previously been bent and twisted by attempting to force the wick past rough deposits.—Drug. Circular.

To Transfer Prints to Glass.—May be accomplished by the following simple procedure: In the first place, the glass receives a thin coating of dammar varnish or of Canada balsam, which has been diluted with an equal quantity of turpentine. This is allowed to dry for a day or half a day, until it has become quite gluey. The leaf containing the print must be soaked in water for some time before being applied to the prepared surface, upon which it should be well pressed down and smoothed out, so as to leave no air-bubbles. It is then thoroughly dried with blotting paper, and, being now firmly fixed the blank portions are carefully rubbed off with the moistened fingers until only the lettering, wood-cut or other impression remains upon the varnish. This is painted over a second time in order to protect it.—Metalarbeiter.

Powders to Make Photographic Developers.—

I.

Pyrogallol	0.3 gramme
Sodium bisulphite	1.2 grammes
Sodium carbonate	1.2 grammes

II.

Eikonogen	1.1 grammes
Sodium sulphite	2.4 grammes
Potassium carbonate	1.5 grammes

III.

Hydroquinone	0.6 gramme
Sodium sulphite	3.4 grammes
Potassium bromide	0.3 gramme
Sodium carbonate	7 grammes

These formulas each yield one powder. The powders should be put up in parchment paper, and carefully inclosed besides in a wrapper of black paper. For use, one powder is dissolved in about 60 c.c. of distilled water.—Drug. Circular.

Liquid Laundry Polish.—The following is said by a German journal to give great satisfaction:

Gum arabic	4 parts
Borax	5 parts
Glycerin	6 parts
Spermaceti	3 parts
Water	60 parts

Mix.—National Druggist.

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